AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 6, No. 50. WEEKLY. | NEW YORK, DECEMBER 15, 1883. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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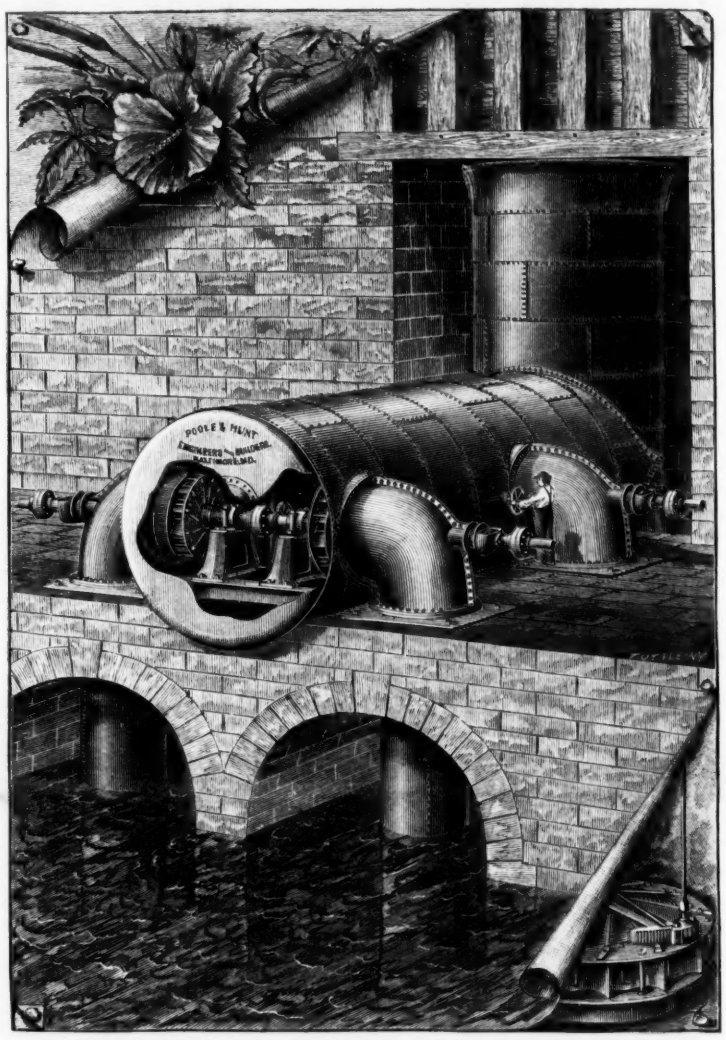
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Arrangement of Turbine Water Wheels.

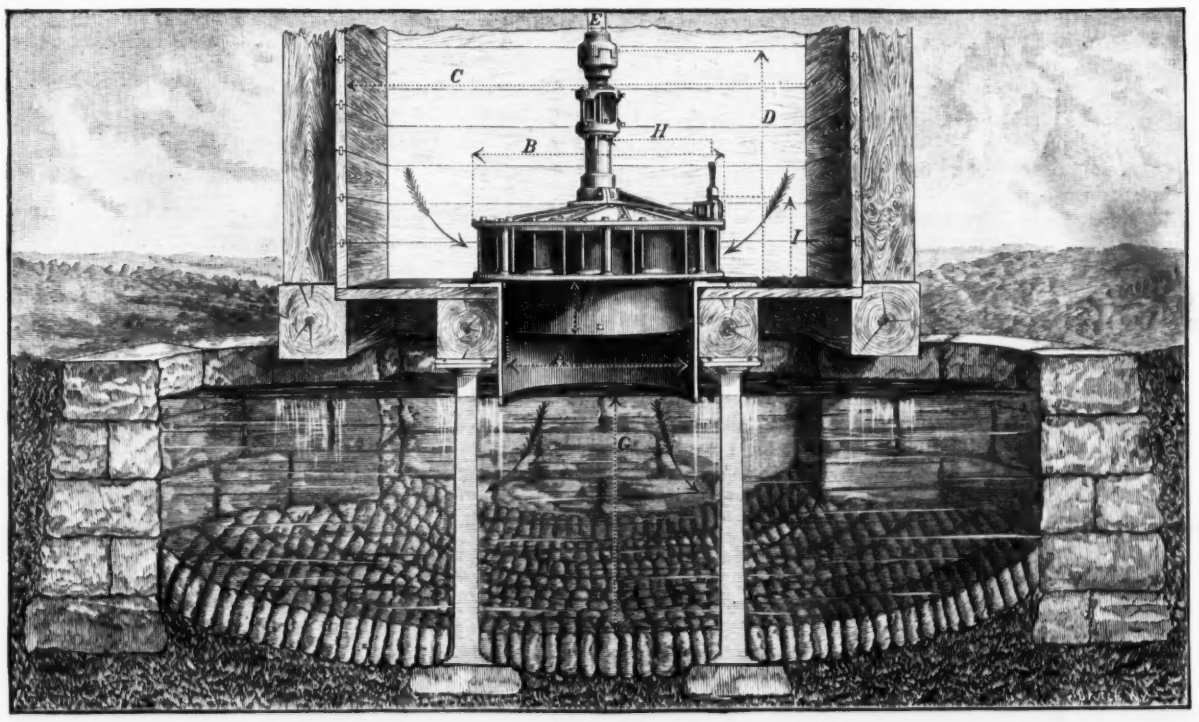
We present engravings on this page representing some of the practice of Poole & Hunt, Baltimore, Md., in setting the Leffel turbine wheels made by them.

The lower cut shows a section of wooden penstock with the water wheel in position. The water is supplied through a short draft tube, which keeps the timber sills out of the water. This not only increases their durability, but also keeps them out of the way of the escaping tail water. The iron supporting columns under the intermediate floor sills prevent settling of the floor, which would throw the wheel out of line. The letters refer to dimensions for a 40″ wheel, as follows: *A*, diameter of cylinder passing through floor of flume, $41\frac{7}{8}$″; *B*, diameter of wheel case, $46\frac{3}{4}$″; *C*, internal diameter of flume, 114″; *D*, height from floor of flume to top of wheel shaft, $51\frac{3}{4}$″; *E*, bore of upper half of coupling, $4\frac{7}{16}$″; *F*, distance from floor of flume to bottom of cylinder, $11\frac{3}{4}$″; *G*, depth of standing tail water in wheel pit, 70″; *H*, distance from center of wheel to center of gate stem, $25\frac{7}{8}$″; *I*, height from floor of flume to bottom of gate stem socket, 19″.

The upper cut illustrates the vertical and horizontal parts of a flume and casing, of wrought and cast iron, containing four turbines on two horizontal shafts. The engraving clearly shows the arrangement.



SETTING OF FOUR TURBINES ON HORIZONTAL SHAFTS IN IRON CASING.



SECTION OF WOODEN PENSTOCK, WITH TURBINE IN POSITION.

Running a Lathe.

SECOND PAPER.

BY FRANK H. RICHARDS.

We come now to another class of conveniences for operating the lathe, which, unlike copious daylight and roomy and convenient shop surroundings, certainly cost nothing, or rather which have a way of more than paying for themselves by the act of collecting them. Among the most valuable of lathe appliances, and the first to be acquired when the lathe comes into the shop, should be a complete knowledge of the lathe itself. Many particulars concerning the action of the lathe, in the way of boring perfectly parallel and facing straight, with the kinks or peculiarities which are apt to lurk about the feed movements, and any inaccuracy of adjustment anywhere, can only be discovered, and slowly at that, by actually operating it. It is my experience that the lathes of even the best makers require some breaking in, and should first of all be entrusted only to a careful and reliable man. A new man, unless you have some unusual guarantee of his trustworthiness, should never be put upon a new lathe.

But I am suggesting now a knowledge of the design of the lathe rather than the peculiar tricks of it, a set of data of its dimensions, and speeds, and relative movements. All knowledge of this character will at some time prove of value to the expert operator. By the expert operator I mean, as we should all mean, the able rather than the old one. It is not merely a happen-so that a young mechanic gets along; it is by means faithfully applied to ends. One who is ambitious, and confident, and commonsensible, must progress. Such a one should have the tool-acquiring instinct strong, and he should not forget, as he sometimes does, that knowledge is the most helpful of all tools. A man's head is his chief tool chest. Strange as it may seem, most lathes go through their lives without finding a friendly operator, sufficiently appreciative to make any full acquaintance with, and still less any record of, their peculiarities. How often it happens, when a strange job comes into the shop and you have doubts of the ability of a certain lathe to take it in, and you ask the man running it precisely how much it will swing, or how much over the rest, or the extreme length between centers that he is unable to tell you. He will measure it for you quickly and gladly; and a month after, if you wanted to know again, he would measure it again; but don't forget that your asking the second time would be betraying yourself. So I think that every shop should have, what no shop ever yet had, a complete record of the dimensions, speeds, and peculiarities of every tool in it. Many of these things naturally accumulate in a foreman's head, but they are continually spilling out of so poor a receptacle. When the lathe or other tool comes into the shop, and is first started, it is a very simple matter, and takes but a few minutes to go over it and jot down its points. Thus, after a time, in the natural course of events, a complete record would accumulate of all the tools in the shop. In a progressive establishment changes of tools occur. I don't believe in running a lathe forever.

Machine tools wear out and they also are continually being improved in design and productive capacity, and there are always fools enough to buy second hand or third hand or tenth hand tools, and nothing pays better than selling old lathes. New lathes also come into a shop in consequence of the natural and healthy growth of it; nothing, to my mind, being truer than that in our age a machine shop must either grow or die. The growth may be jerky and the death may be slow, but one or the other is inevitable.

A foreman should know his tools thoroughly as well as know his men, and when he has occasion to compare the performance of one—tool or man—with another he should know surely whatever he knows at all. If he has occasion to note the fact that one man will use a feed of 40 to the inch, and another 146 under circumstances in all other respects identical, he should know what he is talking about. Sure footing is the only safe traveling in the machine-shop as truly as anywhere. There is nothing so absurd as to try to brace up the discipline of a shop with spongy and elastic rules. No smoking in work hours should mean no smoking. If it is to mean that you may smoke out your after dinner pipe, why

if your pipe is of five hours' capacity you may smoke until quitting time.

As a sample of what may be known, of what would be useful to know, and what should be known by the operative who would run his lathe most successfully, and by the owner of the lathe or his representative, I offer a set of data from a lathe in our shop. This lathe, if not the best ever built, stands high in favor with me, and being the product of an old establishment which has built its thousands, and been widely copied, may be taken as an example of the better class of American lathes:

Swing of lathe 19″
" between centers 4′ 2″
" over rest 7″

This swing over the rest is too little and is the greatest fault of the lathe. Rest has elevating screw and cross feed. Moves along exactly 1″ for each revolution of the crank.

Pitch of lead screw 4 to 1″
" " tail spindle screw 8
" " slide rest screw 6

Speed of counter-shaft 165 per min.
Backing speed 248 " "
Diam. of cone on coun. $12\frac{1}{16}$″, $9\frac{15}{16}$″, $7\frac{13}{16}$″, $5\frac{5}{8}$″
" " " lathe $10\frac{9}{16}$″, $8\frac{1}{2}$″, $6\frac{3}{8}$″, $4\frac{1}{4}$″

Now to find the several speeds of the lathe we begin with the first step of the cone on the counter-shaft: $165 \times 5\frac{5}{8} \div 10\frac{9}{16} = 87.9$ which is the slowest belt speed. Taking the other steps of the cone successively we get for the four speeds without the back gears 87.9, 151.6, 257.2, 445.4. The back gears are 22—64—22—64. Then $64 \times 64 \div 22 \times 22 = 8.46$, and dividing the belt speeds by this we get the speeds with the back gears. The several backing speeds may be got by going all through this operation again, or we may take the speeds already obtained and dividing each by 165, and multiplying by 248, the forward and backward speeds of counter-shaft, we get the backing speeds. We then have all the speeds as follows:

FORWARD.	BACKWARD.
10.36	15.54
17.88	26.83
30.34	45.50
53.73	80.60
87.9	131.84
151.6	227.37
257.2	385.77
455.4	683.1

It will be interesting now to note how nearly the changes of speed are uniform in the successive steps. It is, of course, desirable to have these changes as regular as possible, and a near approach to uniformity will be greatly to the credit of the designer of the lathe. It is not difficult to get the lathe speeds right, but some lathe builders are careless about it. The ratio of the belt speed to the back geared speed is, as we have seen, 8.46; then, the cone having four steps, the normal ratio for each successive speed would be

$$\sqrt[4]{8.46} = 1.7$$

Taking the highest speed of the lathe, and dividing it by the speed next slower, and this speed by the next below it, and so on, we have the succession of ratios: 1.77, 1.69, 1.72, 1,63, 1.77, 1.69, 1.72.

This I consider very good, especially as I find another lathe in shop, a cheap and contemptible imitation of the preceding, whose speed ratios—one of many faults it has—run as follows: 1.55, 1.52, 1.53, 2.8, 1.55, 1.52, 1.53. Upon this lathe, when we throw in the back gears, it makes such a jump in the speed that we have to run one speed too slow about half the time.

Lathe speed is one of the most important questions in machine shop economy, but it is one compelling constant compromises. We can't have all that we want. It is a familiar complaint when we get a large piece in the lathe that the lathe does not run slow enough, and every one to whose attention the difficulty is presented, hastily formulates the original law that every lathe should be speeded slow enough to turn comfortably as large as it will swing. The law will not hold. While true enough of the biggest lathe in a shop, it is not necessarily true anywhere else. The usual work of the lathe rather than the exceptional job should determine its speed; only so can the greatest good of the greatest number be secured. For this reason no absolute speed for a lathe can be given. Two similar lathes, upon different lines of work, would call for different speeds. I have a 19″ lathe which runs too fast to turn 12″, and yet its speed could not be reduced without impairing its general usefulness. This obviously suggests a greater range of speed in the lathe, yet by this move we lose as much as we gain. A certain firm of tool builders is putting upon the market a lathe, which is back geared 16 to 1. This means that with four steps to the cone the speed would double at each change. The following scheme of sizes, if anybody wants it, would do it exactly:

Speed of countershaft, 160.
Back gears, 24—96—24—96.
Cone upon countershaft, 14.4, 12, 9, 6.
Lathe cone, 3.6, 6, 9, 12.
Speeds of lathe, 5, 10, 20, 40, 80, 160, 320, 640.

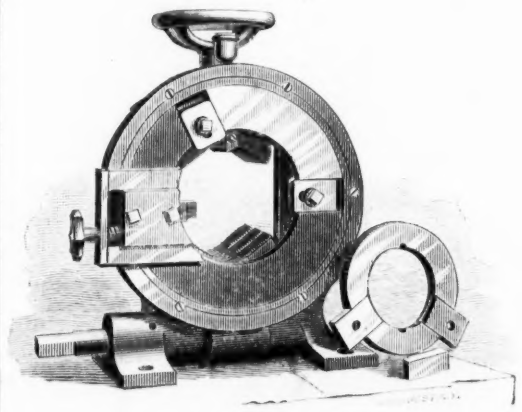
Very slight changes from these cone sizes to secure uniform belt tension need not change the speeds. Five steps, instead of four, to the cone would give 1.75 as the ratio of increase. Such a lathe might be valuable to an amateur, or in a jobbing shop which had but a couple of lathes, but would scarcely find favor in a large establishment. It would be strong at the slow speeds, which is desirable for heavy work; but the depth of the steps would make it difficult or impossible to shift the belt without a stick. The smallest step of the cone being so small, the belt would be very likely to slip upon it, and that nobody pretends to enjoy.

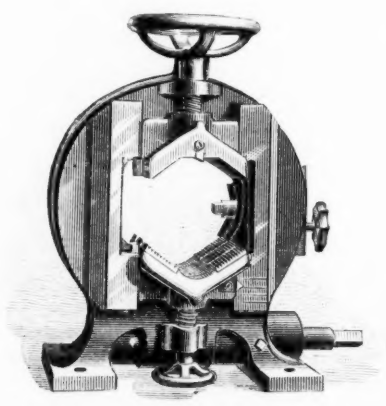
We next proceed to find the several feeds of the lathe. To do this it is not necessary to put a piece of work in the lathe and count the threads traced upon it by a tool. We might do it by computation of the train of feed gearing, whatever that may be; and if a fellow lacks practice in that line, he should set himself to the task and resolutely accomplish it. But we may start the lathe with nothing in it, running it at any speed that will allow us to count it comfortably and throwing in the feed, and waiting until the slack of the feed motion is taken up; then, by applying a rule to the rest so that we can measure its travel, we count the turns of the lathe spindle while the rest moves an inch. We thus find the feeds of our lathe to be 42, 56, 84. The cross-feeds of our lathe, obtained in a similar way, are 56, 75, 112. Lathes in general, in my experience, have not a sufficient range of feed. I have often wished to get hold of a lathe with a variable feed like the Sellers's, but I have not happened to. I fear an increased range of feed would not be generally appreciated, for I cannot help saying—and a fellow isn't to blame for what he can't help—that lathemen lack range of feed as much as lathes do. A mechanical friend was telling me only a day or two ago of a man whom he had lately relieved himself of, who had not used anything but the finest feed upon his lathe in three months. My friend one day changed the man's feed to the middle step of the cone without his knowledge, and it was a week before he found it out.

In addition to these particulars which I have enumerated of the lathe under consideration, and every item of which I assert should be of practical value to the latheman who wishes to run his lathe to the best advantage, and the mode of applying some of these items I hope to call attention to further along—in addition to these particulars will naturally follow a list of all the screw-cutting gears, and a table of all threads possible to cut with them. This lathe, not being so made originally, we have altered so that the screw-cutting gears can be compounded, which is a great convenience and a great addition to the range of its thread-cutting ability at a very slight cost.

Machine for Cutting Off Pipe.

We show with this, in front and rear view, a new tool designed for expeditiously cutting off pipes or tubes of cast or wrought metal. It consists of a vise to hold the pipe, situated at the back end of the case, while at the front end is a worm wheel which carries the tool holder and slide. In adjusting for a certain size of pipe the lower vise jaw is adjusted by means of the lower hand wheel, until the pointer coincides with the graduation on the machine; then place the ring corresponding to the size of pipe in the worm gear, place the pipe in the machine, and clamp by turning the hand wheel at the top. This centers the pipe and holds it firmly. Then by a hand wheel or crank on the worm shaft the worm wheel, and with it the cutter, is revolved, the tool being fed in till the pipe is cut off.





The worm and worm shaft are of steel and the boxes for the shaft of gun metal. The machine is furnished with rings for various sizes of pipes; also with a ratchet wrench to be used to revolve the worm shaft when the machine is used in confined places.

The machine is well constructed: the necessary changes for different sizes can be quickly made. When desired, it is arranged to run by power. It is manufactured by Forbes & Curtis, Bridgeport, Conn.

Bessemer Steel Making.

ABSTRACT OF A PAPER READ BY R. E. JENNINGS, BEFORE THE NEW ENGLAND RAILROAD CLUB.

The manufacture of Bessemer steel was not commenced in this country until 1868, although Bessemer secured his patent in 1857. Perhaps no invention of modern times has exerted so marked an influence upon the human race as that of Bessemer's. His idea was to make steel directly from pig iron. To do this it was of course necessary to remove the impurities which had previously been removed by puddling. Pig iron contains high per-centages of carbon, silicon, manganese and more or less phosphorus and sulphur. The most effectual way of removing these he found to be by applying an exceedingly strong blast while the metal was in a molten state. To get the metal into some kind of vessel which would enable him to handle it at will, he constructed the pear-shaped converter at present in use. This is built of iron lined with fire brick, and shaped as near as may be like a pear. At the top or stem of the pear is left an opening into which the charge is poured. The bottom is made of fire-brick and fire clay, and is about 18″ thick. This bottom is perforated with holes in clusters 10″ or 12″ diameter, and the bottom is so constructed that it can be removed for repairs when worn. Below the fire brick bottom, is another of boiler iron which forms the wind box, from whence the wind passes through the holes into the metal.

The converter is constructed on a heavy iron frame, and stands about twenty feet above the ground. It hangs on transoms, and has wind pipes running down its sides which communicate with the wind box. To the rear of the converter stand the cupolas containing the iron, and in front are the ladles into which the metal is poured. When everything is ready the converter is turned towards the cupola at an angle of about forty-five degrees, the iron is tapped into it, the blast applied and the mouth of the converter turned to its stack. After the iron has been sufficiently purified by the action of the tremendous blast, a quantity of spiegel contained in a third and smaller converter is poured into the mass; this operation being the carbonizing of the iron. At first Bessemer sought to burn out only a certain portion of the carbon and manganese, leaving enough in the mass to form steel. But the quantity left was uncertain, and he found it better to blow out all the carbon and manganese, then return a measured quantity in the form of spiegel. After the spiegel is added, the mass is allowed to remain tranquil for a few minutes until the iron has thoroughly absorbed the carbon and manganese. Then the converter is turned down and the whole mass poured into a huge ladle operated by a hydraulic crane. From here the metal is poured into ingot moulds, each ingot weighing about one ton. The ingots are taken to a heating furnace, heated thoroughly, and rolled in the blooming train into a billet about seven inches square. This is cut into shorter billets according to the weight of rail required, and each billet makes a rail.

A recent consular report says that less than $8,000 worth of machinery, and scarcely $3,000 worth of cutlery and hardware represented these departments of imports into Canton, China, for the year 1882. American clocks are among the most triumphant of imported articles, and seem to have no formidable rivals in Canton. Their honest faces displayed in the windows and on the shelves of numerous shops in Canton, seem to welcome every American as an old friend; and it is a pleasure to bear testimony to their superiority and reliability.

F. W. Dean on the Joy Valve Gear.

The following is from a letter written by F. W. Dean and sent us for publication:

"I am looking up the Joy valve gear on the Philadelphia & Reading Railroad. I have seen No. 358 three times and rode 54 miles on the engine last Saturday. My opinion honestly is that the gear is all right except in one particular, viz.: that there is too much wear of the block. This or bad proportioning, probably, causes the valve to have no lead on the left side, when the right hand crank is down. This sometimes makes it hard to start. When however the right hand crank is up, she starts first-class. In the former case, when she has made half a revolution she is all right. My opinion is that the sliding block should not be used. I feel certain that I could design a radial arm gear for that engine that would run beautifully."

The regenerative gas furnace which we recently mentioned as one of the greatest inventions of Dr. Siemens, is extensively used by steel makers in this country, in what is known as the open hearth process. The Otis Steel Works, Cleveland, O., use the furnace in the production of their well known boiler fire box and tire steel. Steel made by this process is not much inferior to average crucible steel, and is used for many purposes where it is popularly supposed that nothing but crucible steel will answer. The greatest part of the product is used for machinery steel and for agricultural implements. In railroad machinery it is working into service for guide bars, cross heads, crank pins, links, etc.

The Niagara River Cantilever Bridge.

The bridge, of which the accompanying cut is a true representation, is a double-track railroad bridge connecting the New York Central and Michigan Central Railroads. It is located about three hundred feet above the present suspension bridge, where the chasm is eight hundred and sixty feet from bluff to bluff. The grade is two hundred and thirty feet above the surface of the water. Being just at the head of the rapids, it was necessary to build a structure which could be erected without temporary support or falsework. For that purpose the cantilever design was selected, the principle of which is that of a trussed beam, supported at or near its center, with the arms extending each way. The shore ends are anchored to masonry, which acts as a counterweight to provide for unequal loading.

The structure was proportioned to carry (in addition to its own weight), on each track at the same time, a freight train weighing a ton per lineal foot, headed by two seventy-six ton consolidation engines, with a factor of safety of five.

The wind-bracing has been proportioned for a pressure of thirty pounds per square foot on a surface twice the area of one face of truss, plus the area of face of floor system, plus the area of face of train, taken as ten feet vertical height.

The total length of the bridge proper is 910 feet $4\frac{3}{8}$″ from center to center of end pins, divided into two cantilevers of 395 feet $2\frac{5}{16}$″ each, and an intermediate span of 120 feet suspended from the river ends of the cantilevers.

The towers, supporting the cantilevers are 132 feet $6\frac{1}{2}$″ high; each tower consisting of four steel columns, made of plates and angles in sections of about twenty five feet in length, braced with horizontal struts and tie rods. These columns rest on cast iron pedestals, six feet square, which distribute the pressure over the masonry. The caps of these tower columns are steel castings, which carry the cantilevers in a pin-joint.

The trusses composing the cantilevers are made of steel and wrought iron, no cast iron being used. The heavy compression members, such as the lower chords and center posts, are made of steel. All the pins are made of steel. The rest of the superstructure is made of wrought iron.

The shore ends of the cantilevers are attached to short links, revolving on a pin which is anchored to the abutment pier, which serves as an anchorage and at the same time as a rocker to allow for expansion and contraction produced by changes of temperature.

Expansion joints are also provided for at the connections of the cantilevers to the intermediate span in the center, connecting both cantilevers.

The floor consists of 9″x9″ oak ties, and guard timbers 8″x8″, with a plank walk on each side, provided with handrailings, making the whole width of the floor thirty-two ft.

The ties rest on four longitudinal lines of iron stringers 2 feet 6″ deep, which are supported by cross floor beams 4 feet deep, riveted between the vertical posts.

All masonry is built of Queenstown limestone aid in courses two feet thick.

The piers for towers are 12 feet square under coping, 39 feet high, with a batter of $\frac{1}{2}$″ to the foot, and rest on foundations of Beton coignet about 8 feet thick. The anchorage piers are 11 feet by 37 feet 6″ under coping, with a batter of $\frac{1}{2}$″ to 1 foot, and are about 34 feet high. They rest on a platform consisting of twelve iron plate girders, 2 feet 6″ deep and 36 feet long. Under these plate girders 15″ I beams are placed, through which the anchorage rods extend in order to distribute the pressure over the entire masonry.

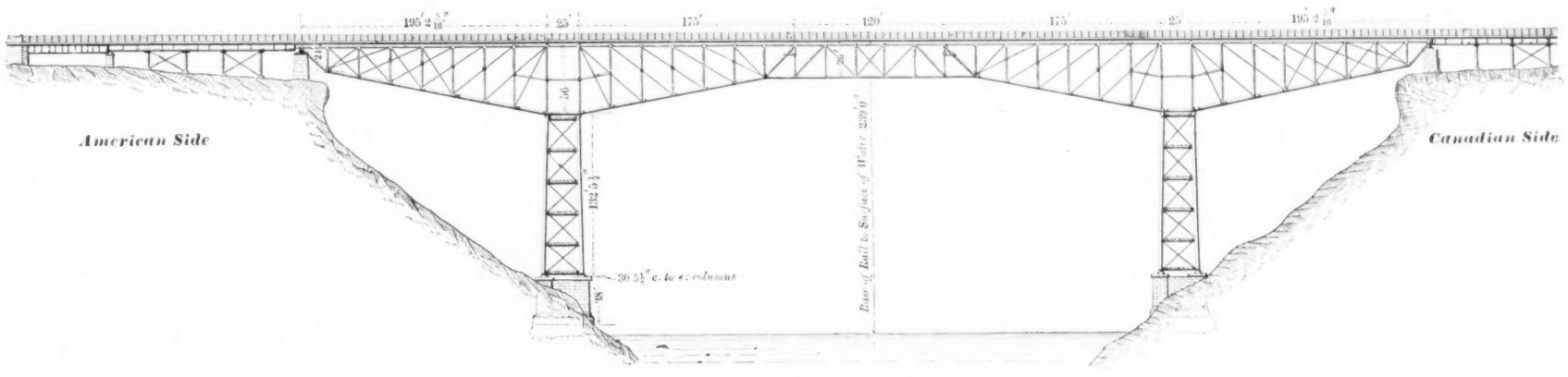
Each anchorage pier contains four hundred and sixty cubic yards of masonry, weighing about 2,000,000 pounds, to counterbalance a maximum uplifting force of 678,000 pounds.

The most difficult problem in this work was the erection. The shore arms of the cantilevers were erected on temporary falsework in the usual manner. For the river arms, however, it was, for the reasons above mentioned, impossible to erect falsework. For this reason the structure had to be designed in such a way that temporary supports were not needed for erection.

After the shore arms were erected and anchored down, the river arms were built from the towers panel by panel towards the river, by means of traveling derricks. After one panel was built and its bracing adjusted, the derrick was moved forward and another panel erected. Thus the work progressed, section by section, until the center panel was reached. The pieces composing the center panel were fitted accurately in place to close the remaining space. Afterwards the fixed connections of the intermediate span to the cantilevers were removed, to allow the expansion joints to work.

The contract for the entire structure was awarded to the Central Bridge Works, of Buffalo, N. Y.

C. C. Schneider is the chief engineer, under whose supervision the plans and the entire work has been executed, and to whom we are indebted for the above description.



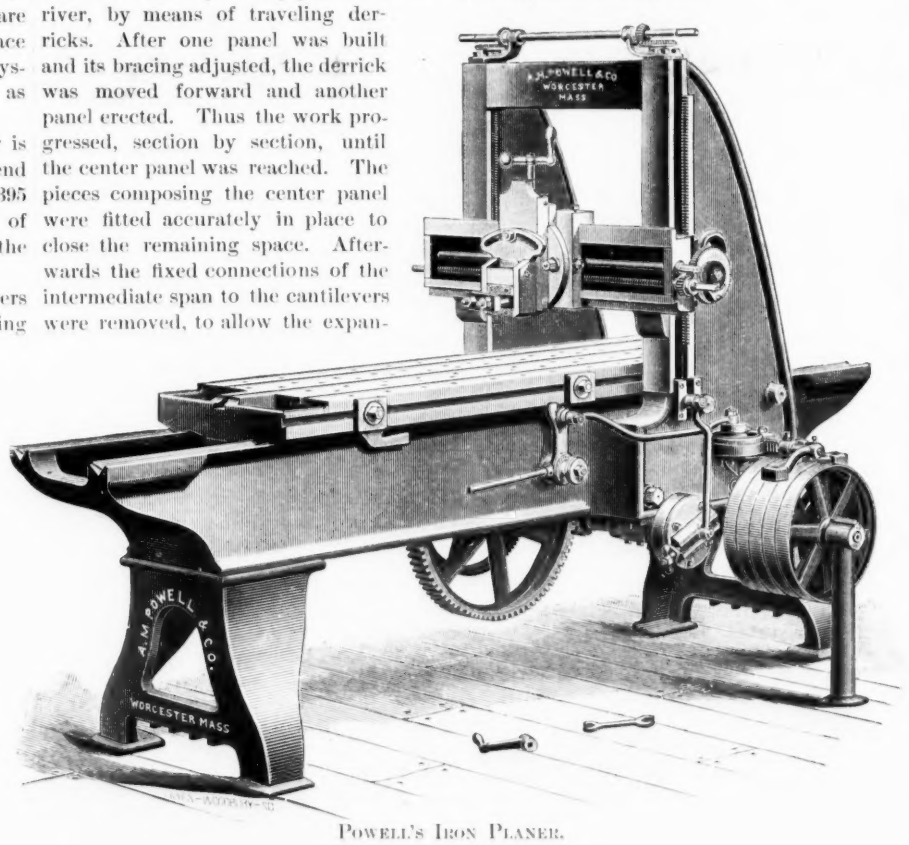
THE NIAGARA RIVER CANTILEVER BRIDGE.

A. M. Powell & Co.'s 22″x22″ Iron Planer.

The planer illustrated herewith, is one recently brought out by A. M. Powell & Co., of Worcester, Mass., and is designed to meet the demands of machinists for a tool that will, with equal facility, operate on either light or heavy work. It is evidently designed with a good deal of care, and while not unnecessarily heavy a liberal amount of metal is judiciously placed to resist the strains due to working. Equal pains seem also to have been taken to distribute the metal to produce pleasing forms.

Of the details, the V's are large, and the table of more than usual thickness. The T slots in table are planed, and the pin holes are drilled and reamed from solid metal. The gearing, including rack, is cut; and the shafts of steel with well-proportioned bearings, have capped boxes. All pinions are of hammered steel. The feed, in all directions, is by means of a friction working a rack and ratchet gears to the rod in cross-bar.

The shipping arrangement is such that the rocker can be entirely thrown out from the dogs on the table, so that the platen can be run back out of the way, for the purpose of examining the work, without changing the dogs. One of the driving belts is shipped before the other, thus avoiding the disagreeable squealing of belts. This planer will plane 22″ wide and high, and is made of any desired length. The weight, with a five foot platen is 4,100 lbs.



POWELL'S IRON PLANER.

Not only cotton but also woolen mills seem to flourish in the South. The woolen mills at Wessor, Miss., have doubled their capacity during the present year. Nearly $300,000 worth of machinery has been added to them and every inch of space utilized, and yet it appears that the mills are unable to keep up with their orders.

A manufacturing city or village is to be established on the Tennessee River in Alabama, near Muscle Shoals. The location is 100 feet above high-water mark, and it will be named "Iron City." It is at the head of navigation on the Tennessee, and will be the terminus of at least three railroads, which run through the coal and iron fields of the South.

Inventor of the Bicycle.

A discussion has been going on in the pages of the *Scottish-American Journal* respecting the question as to who is entitled to the honor of having invented the bicycle. In some parts of Europe the bicycle is becoming an important auxiliary of travel, and is regarded as the poor man's horse. By its aid many workmen are enabled to reside with their families in healthy rural dwellings, away from the moral and physical pestilence of the crowded cities, as they can travel cheaply and expeditiously to and from workshops and factories in the manufacturing centers. From the evidence given regarding the early history of the bicycle, there appears to be no doubt that Gavin Dalzell, of Lesmahagow, Scotland, invented and made a machine as early as 1845, which must be regarded as the prototype of the bicycle. The inventor was in the habit of riding the machine about the county, propelling it much in the same way as the bicycle is propelled to-day, and ample testimony is borne to the truth of the statement. Mr. S. W. Dalzell, assistant engineer on the Pittsburgh division of the Pennsylvania Railroad, is a son of the inventor of the bicycle, and is ready to substantiate the claims made on behalf of his father.

Development of our Crucible Steel Works.

In a paper read before a meeting of the New England Railroad Club, Mr. R. E. Jennings of West Bergen, N. J., gave some interesting particulars regarding the development of the American steel industry. He said that up to the period of our civil war the manufacture of steel in this country was a straggling industry confined to a few small concerns in Pittsburgh, and one in New Jersey. So completely had the English monopolized the trade, and so deeply had they succeeded in planting the impression that outside of Sheffield, nothing made in this line was fit to use, that the American manufacturer found the introduction of his product an exceedingly difficult matter. The agent of the American steel maker was in these days looked upon in something of the same light as the book peddler and lightning rod man is popularly regarded to-day. The manufacturers at Sheffield held their annual meeting in Cutlers' Hall, and decided the scale of prices which should prevail in the United States for the ensuing year. They never sought to enlighten us as to why certain prices should rule. They held our trade largely by playing upon our fears. They knew that the steel consumers here depended largely upon foreign workmen, who brought their prejudices in favor of British steel with them. When the civil war broke out the price of foreign steel advanced to such a point as to be beyond the reach of consumers. Then they were compelled to look towards the small home concerns for their supplies. By the exercise of a little patience on the part of the consumer, and a good deal of patience, skill and experimenting on the part of the maker, it was found that crucible steel of a quality equal to anything made in the world, could be produced right here at home. During the great demand occasioned by the war, and the subsequent years of development up to 1873, the erection of new steel works, and the enlargement of old one, was prosecuted with great energy, so that in 1872 the manufacturer of steel ingots had reached the respectable amount of 36,500 tons for one year. In spite of the depression that succeeded, the steel industries continued to prosper, till in 1882 the crucible steel produced amounted to 85,000 tons.

Electric Lights Inside Boilers.

A correspondent of *Engineering* gives some particulars of experiments made with an electric light inside of a steam boiler. In addition to the electric lamp being placed in its novel position, means were provided for observing the appearance of the boiler while at work, and the experimenters were able to discover cascades, currents, and miniature whirlpools inside. It is expected that this new means of observation will prove useful in the investigation of the causes that lead to priming, and other internal boiler disorders.

Experiments with Leaky Boiler Domes.

On a prominent railroad in this locality, considerable trouble was experienced by the mechanical department, owing to the domes of the locomotives becoming leaky round the base. The engineers in charge determined to search for the source of trouble in a systematic manner, so they stripped a boiler and prepared the means for making tests. In most of the engines the dome was located ahead of the fire-box. While the boiler was cold they arranged the rig shown on top of the boiler in Fig. 1. Screws were set through the end of stationary gauges, so they would loosely touch the base of the dome. Steam was then raised to a pressure of one hundred and twenty pounds, when it was found that the back part of the dome had become depressed $\frac{1}{16}$, and the front part went down $\frac{3}{32}$. This experiment was repeated several times, with substantially the same results. They then had a wooden frame made, and fastened it across the dome as seen in Fig 2, and put screws through the ends within a measured distance of the boiler sheet. When steam was raised, the engineers found that the boiler stretched out about $\frac{3}{32}$ on each side. It was then perceived that the pressure tended to force the circular boiler into an elliptical form, the dome opening being evidently the point of weakness which induced this change of form. As a means of strengthening the dome, they riveted four pieces of boiler sheet, 8″ wide, in the way shown by the dotted lines in Fig. 2. When they tried the boiler for changes of form after this was done, they found it remained perfectly rigid. They have now adopted a strong cast iron ring for strengthening the dome base, which they find to answer the purpose satisfactorily.

A Benefit System in an English Machine Works.

The way one of the largest and best-known machinery establishments in England admits its employes to benefits is shown in the following extract from a late issue of the *Engineer and Iron Trades' Advertiser*, of Glasgow:

"Eighteen months have now passed since the great firm of Tangye Brothers was converted into Tangyes, Limited. The brothers Tangye still hold nine-tenths of the business, and the other gentlemen who have joined the firm had, with a single exception, been associated with Messrs. Tangye in the management of the business for many years before they became partners. The first annual meeting of the company was held at the Cornwall Works last week, and was constituted the occasion for the making of two important arrangements affecting the relations of the firm with their employes. It is well known that the firm have long desired to give some of the oldest foremen and workmen some slight interest in the business, but how this was to be done without conceding them all the rights and privileges of a large shareholder—a course which might be attended with serious inconveniences—was a difficult problem to solve. Messrs. Tangye have, however, at length initiated and adopted a scheme which is likely to work. It is this—a certificate of indebtedness or bond of £50 is issued, setting forth that the holder is entitled to interest upon it at the same rate as the ordinary dividend declared by the company. The bonds have to be renewed at the end of each year, and in case the holder dies before the end of the year for which it is good his family is entitled to the value of the bond. Thus the bondholders enjoy all the pecuniary advantages of shareholders, except that they cannot sell their shares; and they will be free from liability in event of bad times overtaking the concern. The families of bondholders coming under the foremen's trust fund will receive £150 at the death of the holder, without having to contribute one penny towards it. An excellent provident scheme has also been formed for the benefit of all the workpeople.

"At the conclusion of the meeting of the company, Mr. R. Tangye delivered an address to about 1,300 of the operatives in explanation of the scheme. He remarked upon the amicable relations which existed between the company and their hands, and pointed out that for the past twenty-five years constantly increasing numbers of men, now aggregating thousands, had found regular and profitable employment at Cornwall Works. Rarely indeed had any workman been able to say that he left the works through slackness of trade. He hoped that at no distant date they would be able to extend their proposals for the workmen's benefit. If every man and boy would look at the property lying about the works as though it were his own, and resolutely set his face against its waste, the saving would enable the firm to give £50 to the family of every man dying in their employment from natural or any other cause. We do not often meet with a firm taking more care of their operatives.

Mr. Tangye, in his address, stated that special precautions have been taken for dealing with accidents. "After this date the family or friends of any one who may unfortunately meet with a fatal accident whilst working for us, or who from injuries received while working for us shall be unable to work, will, in the former case, receive a sum of money, and, in the latter case, a weekly sum, upon the following scale, without contributing a penny towards it: In the case of death, the friends of youths receiving weekly wages of 17s. or under will receive £25. Men with weekly wages between 17s. and 24s., £50; between 24s. and 30s., £75; and above 30s. per week, £100. In case of disablement, youths with weekly wages of 17s. a week or under, 5s. per week; men with weekly wages between 17s. and 30s., 10s. per week; and those above 30s., 15s. per week. I need hardly remind you that under the Employers' Liability Act, in case of an accident, a workman has no claim for compensation when it can be shown that he has contributed to the accident by his own fault; but we shall make no difference in that respect. The money will be paid in any case, but if you accept our proposal it will be only reasonable that we shall be exempted from any further liability. I want to explain to you that in the course of a few days every person on the ground will be asked whether he agrees to these proposals. He will have to sign in the same way as you sign now for permitting the office to deduct the dispensary money from your wages. If he accepts them, we shall be exempted from any further demand, because, obviously, it will not be fair for the same person to pay twice for the same thing. It will be in no degree obligatory on any one to sign his acceptance of these proposals. I hope the first result of these proposals will be to cause every man who is not in a club to at once join one.'"

Fig. 1

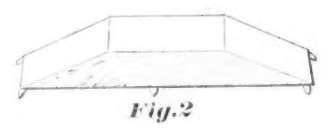


Fig. 2

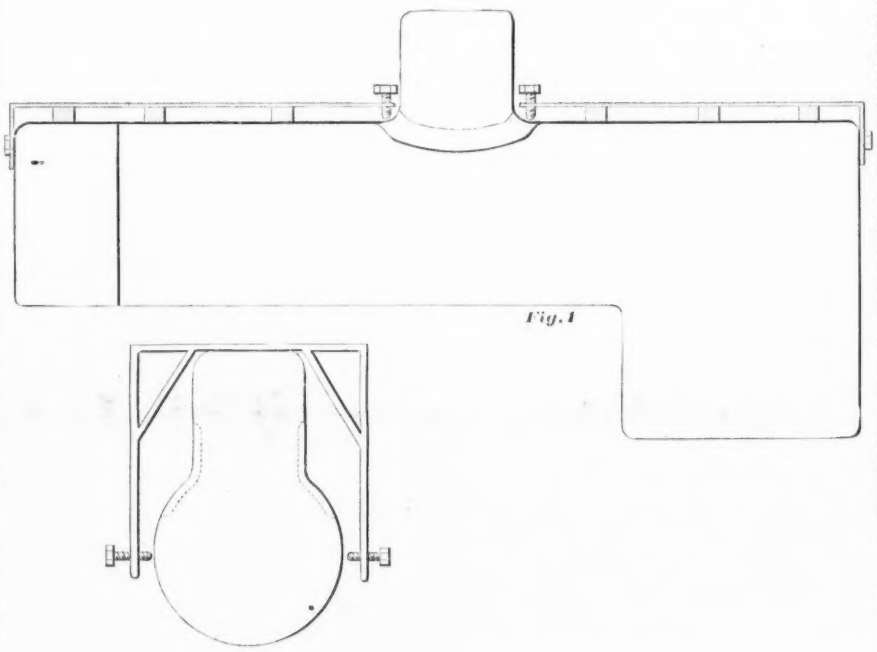


Fig. 1

Fig. 2

EXPERIMENTAL RIG ON A LEAKY BOILER DOME.

Patent on an Old Invention.

In Fig. 1 we reproduce from the *U. S. Patent Office Record* the outline of a device called a car replacer which has just been patented. In Fig. 2 we show a car replacer which has been in use on the Burlington Cedar Rapids and Northern Railway, and other Northwestern roads, for the last ten years to our own certain knowledge. The new patent device is substantially the same thing as has become venerable by use. We expect next to hear of some enterprising inventor making the claim as the inventor, and having a patent granted on the common D slide valve. There are also numerous other useful articles which never received the patent office stamp, and we may expect soon to hear of them being invented in legal form. If we mistake not, the car replacer used by the Burlington Cedar Rapids & Northern Railway was, in several cases, made by them and sold to other roads which did not possess the facilities for making their own tools. It might be advisable for the company to look after the record of that transaction, for it might save them from paying royalty to the patentee of their device. Seriously, this re-inventing old and common devices has become a nuisance that ought to be abated, particularly as it tends to place meritorious new inventions in disrepute from the company they are found in.

A Wonderful Machine.

BY THE OLD MAN.

When I was laying the foundation of my mechanical fame and fortune running a bolt cutter in the Rock Island shops at Chicago a year or two ago, I boarded in a house filled with locomotive engineers and firemen. A practice prevailed there of enlivening the supper table with social conversation, and the locomotive being in the majority the leading theme of talk was stupendous feats performed in getting over certain hills without doubling. This was occasionally varied by the record of minor incidents such as the exploit performed by Tom Jones when the 96 broke her rocker arm, how narrowly Dick Swiveller escaped from having his checks called in when the 124 broke her side rod running down Valley Hill, and how Harry Walbrandt whooped up the 92 to make a passing point, and just got clear into the side track when the Chicago limited showed up.

George Dorwart, who ran a lathe in the shop, sat opposite me at the table, and he got tired of being excluded from the conversation. He became ambitious to hear himself talk in that crowd. One evening catching on in a lull of the talk he called out loudly to me: "Well, I went over and saw that machine to-day, and it is astonishing the fine work it does."

"How does it work?" I inquired.

"Well," said he, "by means of a pedal attachment, a fulcrumed lever converts a vertical reciprocating motion into circular movement. The principal part of the machine is a disc which revolves rapidly on a vertical plane. Power is applied through the axis of the disc, and when the speed of the driving arbor is moderate the periphery of the machine is traveling at great velocity. Work is done on this periphery. Pieces of the hardest steel are by mere impact reduced to any shape the skillful operator desires."

"What in thunder is the machine any way?" demanded Tom Jones.

"Oh, it is a new grindstone," replied George, and a silence that could be felt passed round the supper table.

Notes on Repairing Boilers.

By W. H. H.

* * * * * * *

Getting away from these gloomy matters—suggestive of coroner's inquests—we come to the more cheerful theme of ordinary repairs: You have observed for several weeks considerable steam escaping from the safety valve, and you have also noticed that your fireman has suspended from the lever some of the heavier matters abstracted from your scrap pile. You did not know before what that pile was for, but as any good thing may be overdone a safety valve may be loaded to excess and become a dangerous valve, and you conclude to overhaul and discover the reason for the leakage. On examination you find it to be one of the safety valves of commerce, puny and delicate in its parts, of the kind sold by the dozen with a large discount from card rates. The stem has got askew from the weight upon it, and you straighten it by screwing it in a monkey wrench or a vise, and heaving very gently upon it. You take a fine file and remove the burrs, and are ready to grind the valve to place in its seat. For a grinding material get some of the grit from the grindstone and mix with water for grinding brass, or for iron use emery and oil.

Rotate the valve quickly back and forth, and now and then raise it up and turn round to a new place; do this until the surfaces show an even brightness, then clean everything off and put the valve in place, and pour in a little water, allow it to stand for a time and observe if any leaks away. You put the lever in place, with some tallow upon the pin, and in the guides, and being a prudent man, you wish to know where to place the weight so that the valve may open at the right time. To do this you will have to take your valve apart again—unless you are sufficiently far seeing to have measured its diameter before you put the thing together—and you will have a little sum to do by the following rule:

Square the least diameter of the valve in inches and decimals; this gives an approximate mean area in square inches, upon which the steam may be assumed to act. Multiply this area by the required pressure per square inch, and the product by the distance in inches from the center of the valve spindle to the fulcrum; this final product is the moment of the upward pressure in inch pounds. Divide the final product by the pounds weight of the ball which belongs with the valve, and the quotient is the distance in inches from the fulcrum, to the point on the lever to which the weight must be suspended. If by measuring out upon the lever you find you have not inches enough for your weight, then divide the final product by the inches length of the lever, and the quotient is the weight which will be required. I am of course aware that this method of determining the acting area of a valve is open to criticism, but come on, ye men of mathematics, with your vernier callipers, and your microscopes, and your logarithms r r^2, and get atop of our country friend's boiler, and see if you can agree between yourselves where the weight ought to be, and communicate the result to the AMERICAN MACHINIST.

For example, the least diameter of the valve is 2.5″. Distance from fulcrum to valve spindle, measured on the lever is 5″; required blowing off pressure per square

inch—60 pounds; weight of ball, 100 pounds, 2.5″ squared equals 6.25″ sq. and

$$\frac{6.25 \text{ sq.} \times 60 \text{ lbs.} \times 5''}{100 \text{ lbs.}} = 18.75''$$

(18.$\frac{3}{4}$″) the required distance of the weight from the fulcrum, measured along the lever.

* * * * * * *

In straightening the stem of your safety valve, you may have been so unfortunate as to break it off entirely, so that you have to send it away to get a new stem or a new valve. As you wish to start up Monday morning, you can drive a plug of wood into the valve seat, which is a very dangerous expedient for a prudent man, who would go through with the lengthy calculation spoken of above; or, still better, you can look your scrap pile over, and take out one of those large burrs which the boiler maker cut from the tube sheets, and cobble it up with a face of $\frac{1}{4}$″ thickness gum packing. You will not need to make much of a calculation on the valve lever, but can set the weight when steam is up by the steam gauge. If your gauge is not reliable, you had better throw it away, and buy two good ones.

* * * * * * *

Steam gauges are usually weakened by allowing the spring tube, or diaphragm, to get hot. A gauge, when put up, should have the pipe arranged as an inverted siphon, so that cold water will stand in it at all times when the boiler is in use. The pressure of the steam acts above the surface of the water in the pipe, which pressure is transmitted to the gauge just the same as though the live steam were in direct contact with the working parts. There is a cock fitted at the lowest part of the pipe for draining off the water in cold weather, and for occasionally blowing out the mud. I have noticed many men who have a passion for keeping this cock open at all times, thereby allowing the gauge to become as hot as the boiler.

If the water-gauge cocks are leaky, and they generally are, you will find it a great comfort to grind them in, using again the grit from your grindstone. It is a good thing to have spare ones: also one fitted in the boiler at a lower level than usual, as sometimes boilers are fired up without water inside, in consequence of the watchman not being able to find the water at the ordinary level, and supposing that but a trifle has leaked out during the night.

* * * * * * *

Your boiler is fitted for a water-gauge glass, but the tube has been broken. You find a tube which is too long, and give it a slight nick with a file, and, holding the tube in the two fists with the nick outward from the body, and the thumbs forming a fulcrum next the body, you part the tube without accident, except cutting your fingers, which you will guard against next time. If a file is not at hand, you may take the "solitaire" from your bosom, which you know to be a good stone, as you bought it of Isaac Isaacson, diamond merchant in the Bowery, the last time you were in the city, so you may have no fears of hurting the stone. Your engineer will pack the little stuffing boxes at the ends of the tube with some candle-wick well greased; red and white lead are not good for gauge glass packings, as they harden, and defeat the object of the stuffing box, which is to allow a certain freedom for motion of the glass tube. You may repair a cracked glass when in place by fitting a piece of thin gum packing around it, so that the edges may just meet, and sewing or winding it with strong twine.

* * * * * * *

Your grate bars may be badly broken, or bent; and you find, on examination, that they fit too close in their places, and there is no room for the ashes to drop clear of the ends. You cut away the brick work, which the mason so carefully fitted, and put in an iron bar for a bearer, about six inches away from the bridge.

* * * * * * *

You have noticed that the boiler shows a bagging tendency directly over the bridge wall, and you cut that bridge boldly down, never minding what the fogies tell you about the heat being wasted in the pit, as you remember, when you were at the rolling mill, one of the puddlers told you that the bridge was for the exact purpose of throwing the flame down upon his molten iron; and you looked in his furnace, and so it was.

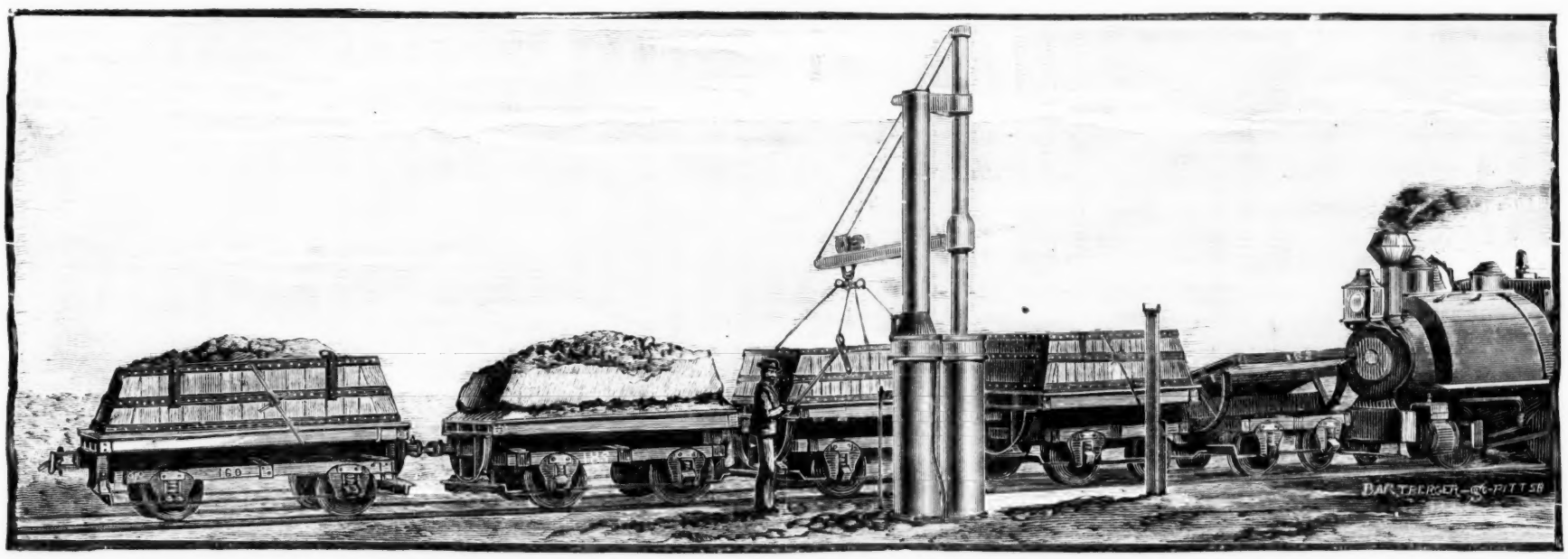
When you got inside your boiler you noticed that directly over this bagged part was a collection of mud and loosened scales from all parts of the boiler, cemented together in a solid mass by a substance resembling coal tar. This tar was caused by a partial burning or decomposition of the oil which has found its way into the boiler with the feed water. It was mixed with the feed water in the heater which you used, which heated the water by passing the exhaust steam directly into it, or else your engine drain cocks, which you have kept open a little all the time, drained their greasy water into the feed water tank.

That part of the boiler which is directly over the bridge is exposed to the most intense heat when the bridge is high, and the upward current of steam and water is supplied by a horizontal current sweeping along with it the solids from the back end. The upward current not being sufficiently powerful to lift all these solids, some of them "get left" at that point; or else, when the fire goes down, the upward current ceases altogether, or from some other causes. The fact is that this is the common result with boilers set with high bridges, and which are not cleaned every week.

You wish to get your boiler into shape, and this in many cases may be done by building a hot fire under the bagged part, and then raising the sheet with a jack screw or lever when a good heat has been attained.

It is well to have the bridge just sufficiently high to keep the fire in place, and then fill up the pit with rubbish and lay a smooth course of fire brick on top, sloping up toward the back end of the boiler; the large pits which we ordinarily see left back of the bridge wall of course make a convenient receptacle for dust, but they increase the amount of brick work to be warmed up every morning, and increase the amount of cold-air leakage into the flue. One who has not seen the experiment tried would hardly believe that illuminating gas can be passed by the ordinary pressure of the main lengthwise through a good hard brick at such a rate as to give a good supply to a 5-foot burner; yet such is the fact, and one which goes to show the importance of having our boiler settings not only soundly built, but also reduced in area as much as is convenient.

In regard to your grate bars, you can make temporary ones with bar iron, and if you require new ones, don't get any of the patent "anti-clinker gas consumers." What you want is a plain double bar; the plainer and easier to cast the better, as that reduces the price per pound, and also makes a bold departure in the form. Let the bar be straight at the bottom instead of fish-bellied, and you will do away with the trouble of broken ends. A good many years ago some mathematical person deduced the principle that a beam of a given weight was stronger when supported upon its two ends and loaded in the middle, if its lower edge was made to conform to the parabolic, or hyperbolic, or gymnastic, or some other curve, and the engineers caught on and applied it to grate bars. They did the same thing in railroad iron, until some rolling-mill man discovered that he could not make so much money trying to roll fish-bellied rails as he could in selling straight ones, and fish-bellied rails became a thing of the past. In these latter days it has been discovered that the straight rail is the mathematically correct form when all the elements which enter into the calculation are considered; and so it will be with grate bars when some of our scientific societies take up the matter.



A TRAIN OF GARTSIDE'S WROUGHT IRON DUMP CARS.

Gartside's Wrought Iron Dump Car.

The engraving represents this car as in actual use at the Lucy Furnace, Pittsburgh, Pa.

This car in its present perfected state is, we are informed, the result of six years' experimenting at an outlay of over one hundred thousand dollars. Of the chills or beds, hundreds were made of every conceivable pattern at an outlay or cost of one hundred dollars each, to be run a few weeks and cast into the scrap pile. For years it appeared to be impossible to get rid of this enormous expense, but by close observation of cause and effect the inventor finally produced the chill, or bed, shown in the cut, which costs no more than an ordinary casting, and will stand all the expansion and contraction to which it is subjected. The first of the present ones made has effected a saving of five hundred dollars in one year, and to all appearances is as good as new.

The same difficulty was encountered with the cars proper, the first ones built having to be rebuilt inside of a year, after an expense of two hundred dollars each for repairs. The present car has been perfected piece by piece, and the first ones built have been in use about two years, costing about five dollars each for repairs, and are, at this time, substantially as good as new. The car is extremely simple in construction, no tools being required but a drill press and forge, and any piece can be replaced without interfering with any other part. The car weighs 10,390 lbs., and the box weighs 3,590 lbs., or 13,980 lbs. complete. It can, of course, be made lighter or heavier as required for other purposes. At these works they are used for short hauls of pig iron, limestone ore, heavy castings, etc., and will carry a fifteen ton casting with ease. They are especially adapted for blast furnaces, rolling mills, steel works, foundries, and for handling hot material, where wooden cars would burn. It would also appear that for railroad grading, tunneling, and ballasting, it would be an improvement on the wooden dump car now in general use, as it has more elasticity in hauling, more rigidity in dumping, and more strength for carrying. In the engraving the car next the engine (No. 162) is represented as after dumping the load; the next one is empty, having the chill or bed clamped in position and ready to be placed under the cinder trough to receive its load of five tons of molten liquid slag. The next one is receiving a chill which has been taken off No. 183 by the steam crane. This shows the manner of changing the chills. No. 183 is ready to be hauled to its destination, and dumped. The last car, No. 160, is a cold car, or one ready to have the chill removed, which will be placed on the car next the engine, No. 162. It will be noticed that the contents of the last car, No. 160, project above the top of the chill. This represents the expansion which takes place in cooling, caused by the slacking of the lime, by the gases, and other causes producing an immense pressure on the chills. The load in some cases expands 33 per cent., and rises high above the bed.

When the cinder is of a limey nature it is like slacked lime, and a portion falls off when the chill is removed. This is no disadvantage, as it is used as a refractory lining (in preparing the cars for receiving their load) by placing a small quantity over the bottom and around the edges of the chill. This answers the double purpose of preventing leakage and sticking to the bottom or chill, being superior to loam or sand as a refractory lining. The chills are taken from the loaded cars and placed on the empty cars at the rate of thirty per hour, after which they are straightened, clamped, and lined, which operation is performed by two men at the rate of thirty per hour, who at the same time keep the yard and tracks clean. When the cars are used for hauling metal or iron of any kind, no bed is required. For stone ore and grading it is more economical to build

the load by placing a wall of lumps around the edges, and the fine stuff in the center; for boiler ashes, and similar light material, a stationary iron bed with hinged sides, is preferable.

In the construction of an iron car the principal difficulty to be overcome is to arrange the parts of iron which have no spring in such a manner as to give the requisite spring or elasticity necessary to prevent rapid destruction of the parts. In other words when the engine strikes the end of a wooden car a hard blow, the sills and all other wooden parts give or bend; but on removing the pressure they spring back to their place; but when iron or steel is substituted the bend remains, and each succeeding blow makes it more, until in a very short time the car is knocked out of all shape. In overcoming this the inventor of this car has combined a spring and oscillating movement, so as to make the whole car a mammoth spring, double acting, so that the pushing strain is directly opposite.

At the Lucy Furnaces there are in use 82 cars and 25 chills, or movable beds. They carry on an average sixty car loads, of five tons each, of furnace slag, which are hauled from two to sixty miles, for a railroad which uses it for ballast, and for other purposes. In unloading three men dump a train of 30 cars in 20 minutes, and the car repairs are merely nominal.

Although, as here represented, this car is specially designed for peculiar service, when the principle is employed for general purposes of course the construction is materially simplified.

Jos. H. Gartside, 41 Willow Street, Pittsburgh, Pa., is the inventor.

LETTERS FROM PRACTICAL MEN.

An Instructive Indicator Diagram.

Editor American Machinist:

Being a constant reader of your paper, and from time to time having seen in it indicator-cards from various engineers, I take the liberty of sending you a card from an engine that was giving trouble. We sent an engineer and an indicator to investigate, and the indicator produced this card. I have seen quite a number of strange and wonderful cards from a variety of engines, but nothing equal to the enclosed. It does not look as though a single slide valve could be set to produce such a diagram.

The engine was 12″x18″, running 175 revolutions, and was fitted with a single slide valve with an automatic governor on the engine shaft; the engine was set to run a certain way, and after it was in place it had to be run in the opposite direction. The engineer, trying to set it, managed to get it so as to take the card as shown (understand, the engineer with the indicator did not set it, it was the other fellow). That engineer cared nothing for such a thing as an indicator.

To my mind it shows plainly the great benefit of using the indicator, even if you do not happen to be an expert in its use. The admission is at *a*. If you see fit, please give the readers of your paper a chance to judge of its value for themselves.

S. E. JARVIS.

A Suggestion for Making Moulding Flasks—A Substitute for the Lengthening Bar in Drawing Instruments—Fitting Keys—A Flue Brush.

Editor American Machinist:

Probably three-fourths of all castings are made in flasks having the old fashioned round guide pins fitting into round holes in suitable plates at each end of the flasks. This requires the parts to be matched and marked. Since no moulder has ever—to my knowledge—suggested a better plan, I hope I may be excused for doing so: Make the pins in the usual way, one on each end of the flask. Make one plate with a round hole, and the other with an *oblong* hole, the long way of the hole in the direction of the length of the flask. This allows room for variation in the distance apart of the pins, and renders the flasks interchangeable, besides saving much time in making the flasks, extreme accuracy not being required.

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In using drawing instruments I have found the lengthening bar has been an unreliable experiment. A very satisfactory substitute for this is made of two corks with a hole through each, and slipped tightly on a rod—a guard of a water gauge makes a good one. Bore other holes at right angles to these to fit neatly the pencil, needle point and other instruments. Use this instead of the dividers. This is not a handsome device, but it is cheap and trustworthy.

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All wheel keys ought to be made of steel, and fitted solid top and bottom. The edges should be parallel, and tapered top and bottom according to circumstances. The point should be fitted slightly the tightest, as the head will generally upset more or less in driving, and become tight.

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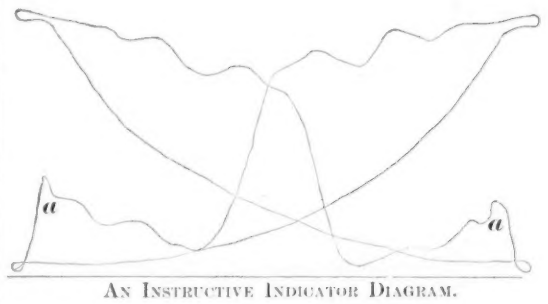
A reliable flue brush for large flues can be cheaply made of steel barb wire. The plan of doing this will probably suggest itself to the engineer without further explanation.

FORTY-NINER.



AN INSTRUCTIVE INDICATOR DIAGRAM.

The Hydrostatic Levelling Instrument.

Editor American Machinist:

Some of your readers seem to doubt the working of this instrument in the manner claimed, in connection with the fine cuts illustrating it some weeks ago.

I suggest that any such procure ten cents' worth of small rubber hose, and, with any two dishes containing a little water, repeat the experiment which I have for years been accustomed to giving my classes, and as shown in the accompanying sketch, viz.: Dip one end of the hose below water in one cup; with the lips draw the hose full of water, and then pinch the hose to retain the water until the other end is lowered into the second cup, below water. Water will then flow until the surfaces reach a level, *A*, *B*. It does not matter how high the part *C* may be, provided it is not over about 30 feet above *A*, *B*. Neither does it matter how low, nor what convolutions are exhibited by the portion at *D*; also the hose can be handled and placed in all sorts of figures without influencing the common height of *A* and *B*, so long as the ends of the hose are not raised out of the water, and kinks are not made so short as to cut off or close up the hose passage.

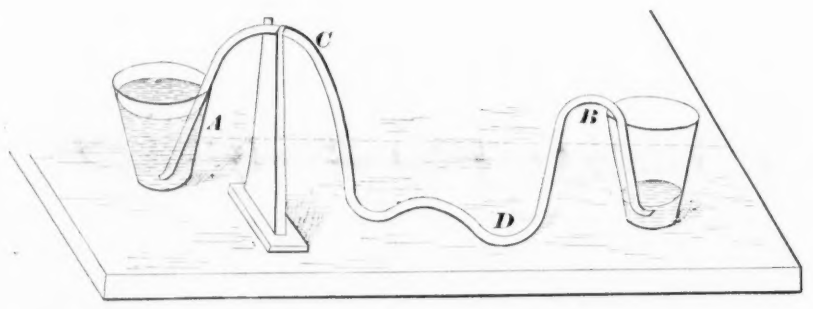
This is nothing but a simple siphon, and the principle is the same as in the instrument in question. In all cases the hose is supposed to be solid full of water.

It is evident that it matters not whether both dishes are on one table, or one on one table and the other on another table. Again, it is evident that one table and dish may be in one room or shop, while the other table and dish is in another room or shop; the hose—10, 100, or 1,000 feet long—passing through an open door, an auger hole, or any other form of opening through the intervening wall, walls, roofs, floors, or what not, provided the dishes are at such relative heights as to allow the water to reach a common level, *A*, *B*, and no point *C* is higher above *A*, *B* than about 30 feet, or that height which corresponds to the atmospheric pressure.

Again, the form of the dish is immaterial to the principle. The hose may enter the dish through a hole in the side, even below water, if the hose stops the hole. The dish may be tall and slender, or it may have a relatively broad base, and the top of the dish may be nearly closed up, leaving only a small air hole at the top; indeed, this dish may be a mere glass tube stuck into one end of the hose, and the other dish likewise.

Any kind of a scale and base for support may be put upon these terminal glass tubes; in short, the instrument is a simple one in principle, and may be simple in construction.

Ohio State University. S. W. ROBINSON.



That Piston Packing Mandrel.

Editor American Machinist:

I hope that R. E. S. has not inferred from my description of the packing mandrel that I turn packing entirely on it, for I do not, and I do not claim to do so, as can be seen by a careful perusal of my article. I face off the outsides only, and a very little facing at that, and I find that I can use three jaws in the chuck for this purpose as well as eight. As to its being patented, I was not aware of the fact, and it certainly was an original invention here. Let us hear how R. E. S. handles his packing, for the wild west absorbs all kinks with pleasure, and, like Oliver Twist, dares to ask for more.

LU. C. SHARP.

Smoke Consumers.

Editor American Machinist:

The inquiry of A. E. K., of Detroit, Mich., in the question column, November 3d, brings to my mind that remarkably truthful saying: "A prophet is not without honor, save in his own country:" and also reminds me of what has seemed a very peculiar attitude taken by some of the scientific editors on the subject of consuming, or preventing, smoke.

First. In reply to the inquiry, and for the good of the craft, there is such a furnace as a smokeless one in the market, and it is made right in A. E. K.'s own city, Detroit, at the Murphy Iron Works. Why it is not more widely known I cannot tell, unless it is because the patentee has had more business than he could attend to, without advertising or making any special effort to bring it to public notice. I saw one of these furnaces at the Cincinnati Exposition in 1879, burning the richest soft coal without a particle of smoke; and during the Exposition, this fall, I saw several in regular operation—the most noticeable being a set in the J. V. Lewis Oil Works; also some other works. There is also a set under the Exposition boilers; and, I was told, some thirty others in Cincinnati alone.

At the Philadelphia Exposition, in 1876, there was a smoke-consuming furnace in operation, built by J. B. Hoyt, of New York. I have not known of this furnace being regularly manufactured and put on the market. It was similar in some respects to the ones in Cincinnati, and appeared to be a practical success. It was smokeless, at all events.

These are the only really smokeless furnaces I ever saw, and I think their performances would excite the admiration of any man interested in steam or chemistry. They operate without any forced or round-about measures, and with natural draft.

It must be admitted by any practical engineer, who sees these furnaces in operation, that such a thing as a smoke-consuming furnace is possible and practicable. Their extended use in Cincinnati would show that they are also profitable. However, even if there had not been a successful smoke-preventing device known, what good reason is there for scientific papers to say that nothing better than the common furnace need be looked for, or that everything depends upon the way in which the fireman puts the coal in the furnace? They might just as well say that no further improvements need be looked for in steam engines, or in electrical matters; or that the success of these hung entirely upon the skill of those who happened to be in charge. Such talk would, of course, be "old fogyism" and foolishness. It would be standing in the way of the advancement of science, and of course they should be the promoters of science. Right here, then, I would respectfully ask, by what right do they presume to single out the matter of "combustion of coal," and set the stakes, as it were, to any further improvement in it? Is that art perfect? Does the average fireman achieve anything like theoretic results? Should we be content with an evaporation of 6, 7, or 8 to 1, when the coal is theoretically capable of twice that duty? I think not, Mr. Editor, and I rise to protest against any further disparagement of effort to accomplish something nearer perfection in that line.

The fireman may be ever so skillful, but he cannot get good results from a poor furnace, any more than a good engineer can get good results from a poor engine. Ordinarily, everything depends upon success, first upon the designer, then the constructor, and last upon the operator. In many processes that have required great skill in the operator, it has been found of great advantage to so change the process that the skill of the attendant could be dispensed with almost entirely. In the case of burning coal, if so much depends upon the fireman, why not take out of his hands, as far as possible, the manipulations of the furnace, and especially the introduction of the coal?

There has been so much ink, argument and foolishness contributed to this one mistake of shoveling the coal *into the fire*, that it is no wonder we have been so blinded to fact that it should not be shoveled in at all—that we have been trying so hard to do a thing right that should not have been done.

In the two furnaces mentioned this seems to be the first divergence from the old rut, and one of the main points of their design. Another seems to be to separate the two ends of the process by commencing operations upon the green coal at one place, and completing the operation by delivering the incombustible gas at another place. In common practice, this is slightly mixed. We find at regular or irregular intervals the fireman opens the door, and throws into the fire a lot of crude material in the shape of cold coal and cold air, and where does it alight? Why, somewhere between the middle and the conclusion (if there can be any such points under such circumstances) of our process, and where we ought to be delivering the finished goods—that invisible and incombustible gas. And what is the inevitable result? Along with the finished product goes a lot of raw material in the shape of black smoke of low temperature, a considerable quantity of combustible gas, and some air. The whole performance shows about as much understanding of the different stages of the process as a foolish miller would exhibit who would occasionally throw into his bolting chests portions of unground grain, where the process, rightly carried out, only permits the finished flour to appear. In both cases the same results would obtain, namely, an unsatisfactory mixture of raw material and finished goods. And in either case, had the raw material been intelligently operated upon first and the finished product last, satisfactory results would have followed with equal certainty.

Another great hindrance to the successful combustion of coal has been the failure to recognize the furnace and the boiler as separate institutions, and for widely different purposes. The sole purpose of the first is to convert combustible coal into incombustible gas; of the second to transmit heat from without to the contents within. In short, the one to produce heat, the other to absorb it. The best furnace will produce the greatest amount of available heat from the least amount of coal, starting with low temperatures and ending with the highest. On the other hand, the ideal boiler will receive the greatest amount of heat for work, and deliver to the chimney the least amount for waste, starting with high temperatures and ending with low. The fact that these two processes are almost exactly opposite suggests the propriety of keeping them separate to a certain extent, and to my mind seems sufficient to warrant the statement that perfect combustion cannot be accomplished inside the boiler, nor too near the outside of it.

I hope this letter may bring to light the inconsistencies of the present methods of burning coal, and show that, after all, there is great room for improvement and need of information and encouragement in this matter. F. B. RICE.

Dunkirk, N. Y.

First Compound Engine on Western Rivers.

Editor American Machinist:

The first steamboat on Western waters to use compound condensing engines was the "Great Republic," built by A. Hartupee, of Pittsburgh, Pa., for the St. Louis and New Orleans trade in the year 1866.

Boston, Mass. JAS. L. HAINS.

Some Queries About Lathe Construction.

Editor American Machinist:

Much has been said and many suggestions advanced on the lathe question. We have had the anvil principle, the beauty of simplicity, the large live spindle, long bearing to the carriage, quickness of adjustment, fine and coarse feed, and many other things of more or less importance. Will you allow me to add my contribution to the general fund?

Why should lathes be built with so slow a belt motion? What is the reason the largest cone of an eighteen inch lathe can not be made at least seventeen inches in diameter? Why should the spindle be four inches in diameter and the smallest cone only five inches? What is to hinder smaller variations in speed, and more of them? Is there any reason why lathes of more than twenty inches swing cannot be triple-geared? What is the use of making a lathe with live spindle four inches and tail spindle only one and three fourth in.? Why should the same spindles have a center only $\frac{7}{8}$″ in diameter and 3″ long? Why can't the head stock be fixed up with some universal arrangement for keeping it in line? Why should some makers still stick to square boxes instead of round ones? Is the lathe so common and inferior a tool that it can't have a friction disc-feed motion with its multitude and great range of feed in both directions? or is this device the prerogative of the boring mill and the milling machine? And last, but not least, let me repeat the suggestion made by others that the apron be changed from an unseen mystery to an arrangement that can be cleaned and oiled without taking the feed works all in pieces?

HERBERT S. WILSON.

A Stripped Nut.

Editor American Machinist:

A few days ago I had the job of repairing a screw press, which had been used on heavy work for several years. The screw was of 3″ wrought iron, and the thread, at a casual glance, seemed to be all right. The nut—of cast iron—was about 10″ in depth, but was stripped of every particle of thread. A new nut seemed to be what was needed, and I put my rule on the screw to find what lead it was. At the top of the screw, where it had seldom been used, it was $\frac{1}{2}$″ pitch, or, two to the inch. At the bottom end, it was less pitch, so much less that in one foot it lost one quarter part of the pitch.

On putting the screw in the lathe the gearing told the same story. The screw by use had become upset, thus destroying the pitch, and the finer pitch of the screw had crumbled the cast iron thread out of the nut. A new $3\frac{1}{2}$″ screw, and the old nut re-cut was the plan of repairs adopted. OLD JOUR.

Oil Cans and Waste—Tapping Holes Straight.

Editor American Machinist:

I would like to ask J. K. C., who writes about oily hands and greasy workmen, what he would do in case every oil can in the shop leaked badly, and all there was in the shape of wipers was the last end of a coat-tail that had been around the shop for twenty years?

I would also like to suggest to Frank H. Richards, or anyone else who is bothered about tapping holes straight, to try my plan. On special engine or machine work of any kind where the tapping holes are always the same size, make a tap with the bottom end straight for say $\frac{5}{8}$″ or $\frac{3}{4}$″ or, perhaps, more, to just fill the tapping hole. The correctness of the tapping will then depend on how well the straight end of tap fills the hole. This end of the tap may be left quite hard, at the tip at least, and will then probably last as long as the rest of the tap. F. R. H.

Knowing How to Learn.

Editor American Machinist:

One of the most important things that a young man can learn, is how to learn. To be groping in the dark all uncertain of what there may be one step in advance, or one step to the right or to the left, and with no means of finding out, until some obstruction is stumbled over, or some pit fallen into, is the miserable condition of many hard working men, only because they have never learned how to find out the things which they need to know.

One day, wanting an errand done, I said to the youngest boy in the shop: "Henry, do you know where Mr. McKee is at work?" "No, sir, but I can find out," was the prompt answer. I knew at once that I had found a messenger who would fill the bill; what was essential for him to know, he would find out.

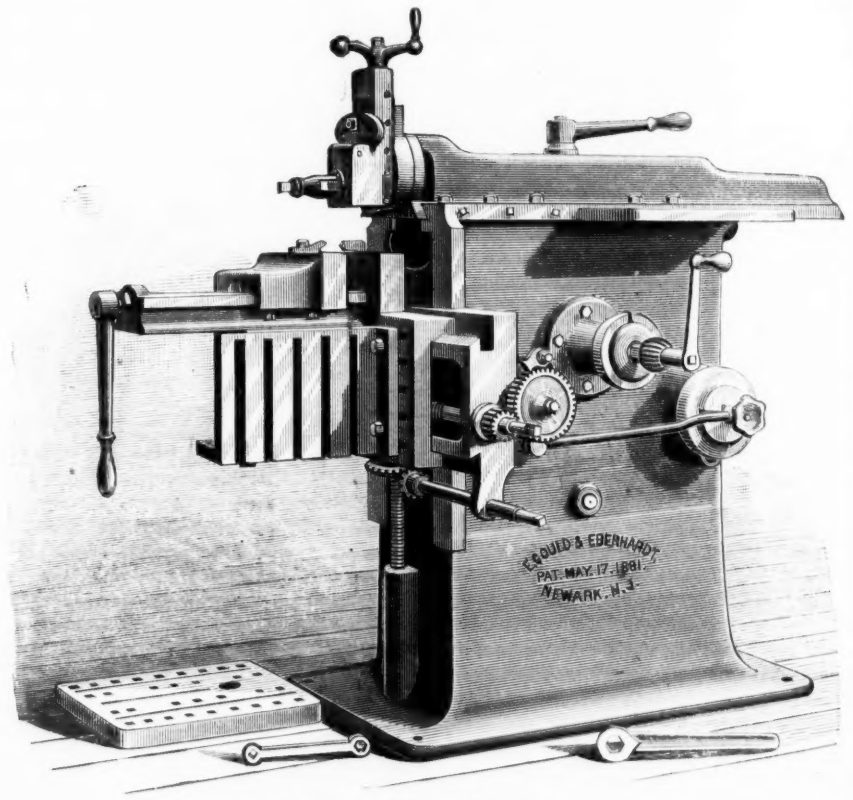
Enquiry, observation, taking notice of how work is done, or how it may be done, thinking about it at the time and afterward, contriving various ways of doing the same job, supposing cases, making plans ahead of actual work, and *carefully* reading the AMERICAN MACHINIST, are some of the means used by those who know how to learn.

In the early days of my apprenticeship I made a plan, in advance of the work, for boring a seven foot crank for an engine. There was no lathe in the shop that would swing it, and I had never seen anything bored that would not swing in a lathe. My plan was to put the crank on the lathe carriage, and fasten a projecting tool to the face-plate.

I said nothing about this, and when the crank was put on the very carriage that I had chosen I was quite elated, but when a boring bar was brought out, and I had comprehended its use, I felt cheap enough. But my chagrin only called my attention to the boring bar and cutter the more closely, and after the first blush of mortification, I was never sorry that I had made the attempt to think in advance of the work.

F. J. MASTEN.

Among the exhibits mentioned at the late Swiss National Exhibition, by a consular report, was an automatic screw-making machine of native manufacture, which attracted universal attention. Connected with the machine was a contrivance for picking up the prepared iron, passing it down to a pair of iron fingers which seized it and held it as in a vise till the thread was cut. The screw was then cut off and instantly another rod was picked up and presented to the cutter. Human hands could not do the work with more precision than was done by this apparatus for all sizes of screws. The department was full of most novel and important machinery, and the report expresses surprise that so much ingenuity of invention could be found in a country having no protection in the shape of patent laws.



IMPROVED SHAPING MACHINE.

Swiss and American Watch Making.

At the Centennial Exhibition the manufacturers of American watches demonstrated that, by the judicious use of special machinery, they were able to produce watches cheaper than they could be made in Switzerland, which had previously been regarded as the headquarters of watch-making industries. Our watch manufacturers threatened to push the Swiss makers out of the market. Their achievements in this direction can hardly be considered successful. Instead of our manufacturers selling watches in Switzerland, that country disposed of over $700,000 worth of watches during last year to our home market. Something appears to be wrong here, when we were so near monopolizing the watch trade of the world seven years ago. Investigation into the matter shows that the Swiss makers did not wait to be undersold, but accepted the lesson of their rivals in an intelligent and practical way by introducing our most perfected machinery to aid their processes. In addition to this, they retained the manual skill in the business which they have acquired by generations of experience, and they adopted new methods of developing skill likely to prove valuable to their work. Special schools were established for children, where the work of watch making became part of the instruction. By this means young fingers are trained to acquire dexterity while they are plastic, and those alone who exhibit an aptitude for the work are selected as apprentices to the trade. A systematic selection of the fittest, such as this plan indicates, cannot fail to exert a powerful influence in facilitating production of good work. Our watch-making industries have evidently lost an opportunity of taking the world's lead in their business. If they desire to regain their lost prestige they must not only keep their fertile inventive faculties active, but they must profit by the tactics of their rivals and organize better methods than are now in vogue for selecting the youths best fitted for watch-making work. A modification of our common school work, which would vary the monotony of mental exercises for light manual tasks, would in many cases benefit both the head and the hand.

Improved Shaping Machine.

The accompanying engraving represents the recently improved shaper built by Gould & Eberhardt, Newark, N. J. In re-designing this machine, the bearings have been made longer and larger, and various improvements made. The vise for holding work is arranged to be quickly removed, leaving a plain flat surface upon which to bolt work. All gears are cut, and the pinions are made of steel, as well as all screws. The feed screw is of coarse pitch, so that wide finishing cuts can be taken. The wearing parts are fitted by scraping, and wrought iron work case hardened.

The colored people throughout the various States have formed an organization for the purpose of holding a grand industrial exhibition in New York next year. Parties desiring to obtain space in the exhibition are recommended to send in their names to the Committee on Exhibits, 218 Sullivan Street, New York.

"Chatterbox Junior" is the name of a finely illustrated book for children, just issued by R. Worthington, 770 Broadway, New York, at $1.25. In these days of abominable trash books for children (many of them unsafe for juveniles to read) it is worthy of note when a wholesome, entertaining and instructive book like this, makes its appearance.

A recent issue of *Engineering* contains a short account of a trial of a small pumping engine designed to pump 75,000 gallons of water 150 feet high per hour. The average indicated horse power was 78.2, and the coal consumption per horse-power per hour 1.92 lb. The pump horse-power was 61, no allowance for friction being made. The coal consumption per actual horse-power, measured from the water lifted without any allowance for friction of water in mains was 2.461 lb. This seems to be a very favorable showing, particularly when it is considered that the steam pressure was only 40 lb. We are not informed of the type of engine.

An English boiler-inspection company recommend the use of soda ash in preference to soda crystals for preventing the formation of scale in boilers. Only that of the best quality should be used, as it may contain impurities that would injure the iron. The soda ash, they recommend, shall not be introduced into the manhole or hand holes in large quantities at a time, but should be pumped in regularly with the feed water.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.

JACKSON BAILEY, Vice-Pres't.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, ANGUS SINCLAIR, } Mechanical Engineers.

The American News Company,
Publishers' Agents, New York.

The International News Company,
11 BOUVERIE STREET (Fleet Street), LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage prepaid.

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The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

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$3.50 to Foreign Countries, postage prepaid.

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"Business Specials," 50c. a line.

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NEW YORK, DECEMBER 15, 1883.

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Firemen vs. Coal Shovellers.

ONE of the really important positions to be filled around an industrial establishment, and strange enough, the one that nine times out of ten receives the least attention, is that of fireman. Thousands of dollars are paid for the best ideas, embodied in a steam engine that will give a high duty under expert firing, all for the sake of economy, and then a man without ideas—a certain amount of muscle to shovel coal, and willingness to work cheap will be put at the boiler, just where economy must begin, if anywhere around the plant. Economical firing is really an art, and one only acquired by a good deal of practice and study of some kind. No one knows better than a good fireman how easy it is to waste, in coal, the amount of his wages, and he understands equally as well how little his waste will be condemned, or his saving appreciated. In regard to other losses—the damage he may do—no one seems to care particularly; repairs come as a matter of course, and is a subject for discussion between boiler-makers and boiler-owners. Often less ability to shovel coal, or at least less willingness, would work an important saving in the coal pile. Always a fair amount of skill, fairly paid for, represents a good investment.

We have occasion to remember an instance—more than one, but this one in particular—that illustrates the value of good firing as well as how good firemen are sometimes appreciated. It was that of a party who contracted to make alterations to a hundred horse power engine, which was supplied with steam by two boilers. By the terms of the contract, after the alterations it must be possible to run with one boiler, no further specifications of the economy resulting from the alterations being required. The alterations were completed, but the fireman could not keep steam with the single boiler for an hour. Finally the party who did the work, to test the matter and to get his pay, or satisfy himself he had fairly forfeited it, sent a man to attend to the firing. This man kept steam for a week with a single boiler, the gauge pointer marking eighty pounds all day with a certainty that suggested a suspicion that it might be permanently fastened there. The saving in coal amounted to just about the ordinary wages of two firemen, and yet the owner would not give him a permanent job at more than about what he could hire an ordinary laborer for, preferring to use the two boilers, and pay for the extra coal and extra repairs. Of course this was strictly his own business, but it was not particularly encouraging to the man who had learned the art of firing, and found that he could not get ever so modest a per cent. of what he saved, for his knowledge. Of course this is not always the case, for fortunately a good fireman is sometimes appreciated—and paid. The trouble is, generally, in not recognizing the fact that any more skill is required to shovel coal into a furnace, than, for instance, to shovel dirt off a wagon, and hence that none ought to be paid for.

A manufacturing concern we know of, one that does a good deal in the way of pumping machinery, understands this matter thoroughly, and in their duty tests send out an expert fireman who happens, as well, to be one of their most valued machinists. This man does a good deal towards raising the record, and could do a good deal in the way of keeping it up; but who that buys their machinery would pay him fifty cents a day more than he could hire a coal shoveller for?

Some time the idea of coal, and dirt, and ashes, will get permanently separated from the man who handles them, in the fire room, which will be a bad thing for the coal shoveller, a good thing for the fireman, and a better thing for the man who pays the coal bills. The tests that are made from time to time, showing the possibilities of good management, compared with the results that obtain with poor management, will not always fail to educate. What *could* be learned from them is that thirty tons of coal are frequently paid for to do what twenty tons are sufficient for, and that the greater part of this loss may be looked for in the fire-room. Builders of steam engines will make their guarantees on the water consumption, sell their engines, and demonstrate that they will run on about two and one-half pounds of coal with careful firing and good boiler-room management; and these same engines will be put at work and nearer five pounds will be shovelled into the furnace—not used in any fair sense of the word. It costs money to get power with a man who was not intended for a fireman in the fire room, but keeping him there seems to be a luxury that a good many cannot deny themselves.

A New Use for Worn-Out Boilers.

An enterprising inventor has patented a "cyclone refuge" which consists of a "metallic chamber sunk in the earth, having suitable means of ingress, egress, and ventilation." The arrangement has a striking resemblance to an old boiler turned into a cyclone refuge. Should a demand for refuges of this kind arise in the cyclone-infested regions, what an excellent market it would provide for old, worn-out boilers. A belief might be cultivated that old boilers were better adapted for this purpose than new ones, and they might by that means obtain a value that would create a lively demand for them. By this means numerous boilers that never grow old enough to replace till they go to pieces, might have their sphere of usefulness changed in time. Instead of raising a cyclone of steam and water, that generally finds more victims than the wild winds, they might see many years of usefulness, in providing an ark of safety. This would lead to a far nobler end than that of spreading death and destruction among helpless people. By all means let us encourage the demand for the cyclone refuge.

The discovery has been made in Texas that a barb-wire fence can be put to other uses than that of wounding animals that rub against it. The sexton of a Fort Worth cemetery connected two telephone wires with the two topmost wires of the barb-wire fence, and found that his telephone worked first-rate for the distance tried—half a mile. Another party then tried a barb-wire fence with a telephone over a two-mile circuit, which also worked satisfactorily. No insulators were used on the posts.

This discovery can be made very useful on Western farms, where barb-wire fence is the kind generally used. When lightning-rod agents and collectors of royalties for using patented devices make their rounds, they need not go out into the fields to see the farmer, but can halloo at him from a safe distance. It would also, in all probability, prove to be quite a saving to the farmer himself, as he could not send his signature to a ninety-days' note by telephone, and after thinking over the matter carefully, during the time it takes him to go from his work to the other end of the fence, he would most likely decline to append his autograph to the note.

Iron Trade Notes.

The drop in the price of steel rails to $35 per ton has given rise to rumors of a further decline, and offers for large lots at $34, with a strong probability of transactions at that figure. Improvements are being introduced, which will further reduce first cost. All through the fall large orders have been withheld, because of the knowledge that $37 could not be held, and that $35 would be named as the price, sooner or later. For the same reason, orders at $35 are coming in rather slowly, and it is confidently believed that by the time orders must be filled rails can be had at less than $34, which is now the lowest price offered for large lots. The bottom price for steel rails is an unknown quantity at present. The "direct process," the "soaking pit" automatic machinery for handling rails in the rolls, and several other devices which are about to be introduced in our Bessemer mills, will greatly reduce the cost of production, and make it probable that rails will soon sell even lower than now. There are Bessemer mills in this country with 38 converters, each with a capacity of 269 tons per turn. This is equivalent to a capacity not much under two million tons per year. Rail making has largely fallen off.

The rolling mill industry throughout the country is depressed, but not to the extent that has been reported. Mills are changing from double to single turn, while here and there fires are being put out, and there is no disposition to accumulate stock. Stocks of bar iron in consumers' hands are also very light. Stocks of pig iron have declined 100,000 tons within four months. Iron for engineering purposes is in better demand than any other kind. Bridge and ship work, and building construction requirements, and iron for car purposes are being called for in large lots, and nearly all mills engaged in manufacturing these kinds of iron are favorably situated.

The foreign iron market continues weak and dull. Shipments to this side are falling off, and very few orders are going abroad. The situation in pig iron will probably improve sooner than in other directions, because of the unwillingness to blow furnaces in when they are once out.

At a leading Eastern steam gauge manufactory an order was recently received, by telephone, to send a man to remove a gauge recently purchased at the works, the intimation being unmistakable that it wasn't good for anything, inasmuch as it wouldn't register above 80 pounds pressure, as any well-regulated steam gauge should do. The gauge was taken to the works, and looking through the glass (dimly) a stop was seen at the 80 lb. mark, which manifestly had declared an interference with the progress of the pointer beyond that point; judging from the evidence before the eyes of the superintendent, some one had been fixing things for a first-class "accident" to a steam boiler, and the question was, who fixed it? In order to investigate further, and see just how the stop was placed in the dial, the glass was removed and the "stop" found to be a small screw that had somehow found its way between the glass and dial and become firmly wedged in place, making a first class abutment.

It will be remembered by many of our readers that several years ago a short railroad which had been opened in China was abandoned, and the track torn up, through the enmity of the native authorities. Another attempt has been made to establish railroad communication among that conservative comunity. At Kaiping, a place about 70 miles north of Tiertsin, extensive coal mines have been opened by a European company, and a railroad 7 miles long has been opened in connection with the works. A locomotive built in China has been used in operating the railroad. It is expected that the successful operating of this short road will lead the way to extensive railroad building in China.

A recent consular report, speaking of a species of iron wood that grows plentifully in Southern Mexico, says, "the wood makes the finest railroad ties, and they are so heavy that they almost ballast themselves." The writer of the report evidently thinks that ballast is used to hold a tie down, just as it is employed to sink a ship deep enough in the water for stability.

Literary Notes.

A TREATISE ON CRANES. By Henry R. Towne, *Mechanical Engineer*. Published by the author at Stamford, Conn.

This book contains a comprehensive description of the cranes and hoisting machinery made at the works with which the author is connected, and at the same time includes a presentation of the general subject from an outside standpoint. Various types of cranes are illustrated and described, together with the details of their mechanism, the whole making a book af nearly 200 pages of matter, that will prove interesting to those in mechanical pursuits, and from which much useful

information may be obtained. The author is well known as having made the subject of cranes a special study, so that what he writes upon it has been well considered.

Ranck's Guide to Lexington, Kentucky, is a book of about 100 pages, fully illustrated, describing nearly everything a stranger would want to know about that town. One object of the author is to induce manufacturers to locate in Lexington. He says: "She wants pushing, enterprising, experienced manufacturers, regardless of where they come from or to what school of politics they belong, if they are willing to help us build up the town." It is published by G. W. Ranck, box 255, Lexington, Ky.

In another column we publish particulars of "A Benefit System in an English Machine Works," which is worthy of wide imitation. It would be impossible for many employers of labor to aid their workmen to the extent done by Tangye Brothers, of Manchester, England, but a small effort in that direction would convince the men that their employers did not regard them merely as so many producers without a thought of their comfort and material progress.

At this point the political economist steps in and asserts that an employer's duties cease when he pays the workman the value of his labor. This is the ironclad law which recognizes no sentiment, and would eliminate benevolence from the human heart. Apart from its cold-blooded inhumanity, the political economist's method of treating employes does not pay in the end, for men will do better work and their co-operation can be relied upon in times of trouble, when they have the consciousness that they have been treated as men.

Opinions of Contemporaries.

From the Sanitary Engineer.

We have always admired the way in which our contemporary, the AMERICAN MACHINIST, has been conducted, and it is gratifying to see that success rewards the adoption of the methods employed. The proprietors have decided to reduce its price, and they make a straightforward statement of their reasons for the change, and their expectations as to the results to follow it.

In regard to circulation, an affidavit is presented from their printer which states that for the last six months it has been 16,000 weekly.

From the American Artisan.

The AMERICAN MACHINIST has changed its price from $3 a year, or six cents a number, to $2.50 a year—five cents a copy. The AMERICAN MACHINIST is the best paper of its class that we know anything about; and if there is a machinist, stationary or locomotive engineer in the country who is not now a subscriber to it, he should at once avail himself of the opportunity, otherwise he will be without excuse if he does not keep abreast with the remarkable progress of his trade.

From the New York Daily News.

The AMERICAN MACHINIST has reduced its price to five cents a copy and $2.50 a year. It is an excellent paper for workers in iron.

From the Bulletin of the American Iron and Steel Association.

The subscription price of the AMERICAN MACHINIST, one of the very best technical journals in this country, has been reduced to $2.50 per annum. It is a weekly publication.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(390) Engineer, Yarmouth, N. S., asks: 1. What is the weight of a cubic inch of mercury? *A.*—.4911 lbs. 2. What is the expansion of mercury for each degree increase of temperature? *A.*—.00010085 of its bulk.

(391) Subscriber, Rockford, Ill., writes: I have been constructing a mercury gauge, made similar to a barometer, the upper end of the tube connected with the condenser. From what point shall I commence to graduate it? *A.*—From the level of the mercury when the tube is disconnected from condenser.

(392) C. W., Hamilton, Ohio, asks: How are the figures and lines made on steel tapes? *A.*—An examination of a steel tape shows, beyond reasonable doubt, that in that instance, at least, the figures and lines on the polished tape were covered with some substance—wax probably—and the rest of the surface treated with acid.

(393) High Speed, Cleveland, Ohio, asks: 1. What is the centrifugal force of a weight of one pound revolving in a circle of two feet diameter, at a velocity of 100 revolutions per minute? *A.*—3 4-10 lbs. 2. Force turns a fly-wheel 100 revolutions per minute. Will it take twice or four times the force to double the velocity in the same time, starting in both instances from a state of rest? *A.*—Four times.

(394) S. E. W., Penn., Ill., sends samples of boiler scale, and asks: 1. What are they composed of? *A.*—The samples are composed mostly of carbonates of lime and magnesia. 2. What shall I do to prevent its formation, and is it dangerous? *A.*—You can do a good deal in the way of preventing the formation of the scale by using a surface and bottom blow. It is not a particularly dangerous scale; on the contrary, it is more than ordinarily porous; still, you should, as far as possible, prevent its formation.

(395) C. N., New York, writes: In your issue of July 28 the nominal power of the engines of the S. S. Aurania is given at 1,500 horse-power, and the actual at 8,000 horse-power. I always supposed the nominal horse-power was more than the actual. What is the nominal horse-power of an engine? *A.*—The nominal horse-power of an engine has come to be nearly meaningless. It had some significance in the early days of the steam engine, when slow piston speed and low steam pressure were the rule. The British Admiralty's rule for nominal horse-power is based upon a steam pressure in the cylinder of 7 lbs., and a piston speed varying with the stroke, but in all cases slow. With higher pressure and speed the actual horse-power is much above the nominal. In other instances, the nominal horse-power is rated from different pressure and speed.

(396) G. T. E., Buffalo, N. Y., asks; Does a piston of a moving locomotive move backward and forward, and does the top of the locomotive wheel move faster than the bottom? *A.*—The piston of a running locomotive moves backward and forward, and is not influenced by the changing position of the engine. While moving backward the piston may be carried ahead in space, just the same as the locomotive itself may be carried backward in space through the earth's velocity while running at its greatest speed. All parts on the circumference of a rigid wheel must move at the same velocity if the axle is placed in the center. The contradictory man who sits with his feet on the counter of the grocery store, and argues the old stereotyped fallacy that a piston cannot move backward when a locomotive is running ahead, and that the top of an advancing wheel must move faster than the bottom, is a pestiferous fraud.

(397) W. T. S., Salem, Ohio, writes: We have a 5"x7" plain slide valve engine, which we wish to run 500 revolutions per minute, with a boiler pressure of 100 lbs. The steam pipe is 1" diameter, 8 feet long. The exhaust is through two nipples, 1¼" diameter, on a 1¼" elbow to a tin pipe, 2" diameter. The pulley on engine is 18" diameter, and that on line shaft 28". The line shaft is 10 feet above engine. We would like to know: 1. How wide a belt will be required to transmit the full power of the engine? *A.*—If the line shaft is directly over the engine, any belt will work unsatisfactorily. Your steam and exhaust pipes are quite too small for the proposed speed. The steam pipe should not be less than 1½", and exhaust pipe not less than 2". Quite likely the engine is not constructed to run at that speed. We should say an 8" belt, well arranged for driving, would transmit all the power you will get from the engine. If the pulleys are located one directly over the other, use a 10" belt. 2. How much chop will such an engine grind in a light feed mill? *A.*—We have no means of determining.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Match Machinery, F. Chillingworth, New Haven, Ct.

F. VanWinkle, Mech. Engin'r, 22 Cortlandt St., N. Y.

James W. See, Consulting Engineer, Hamilton, O.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Metal & Wood Patterns—G. D. Lambert, N. Haven, Ct.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

4x4 engines, stationary or marine. N. C. Heaton, foot of 20th Street, Brooklyn, N. Y.

"Tack Machinery"
Willets Manufacturing Co., Providence, R. I.

Consulting Engineer and Mechanical expert, C. C. Hill, 144 LaSalle street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

For sale, lathes of best designs from new patterns. George A. Ohl & Co., E. Newark, N. J.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh Wells, & Co., corner Fulton and Dutch streets, New York.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Slide Valve Working Models. Send for circular. See notice in this paper, October 13, page 9. E. E. Roberts, 107 Liberty Street, N. Y.

Jack pump and ladder chain machines, 40 to 80 links per minute, direct from coil. The Gaylord, Cross & Speirs Company, Waterbury, Conn.

The "Wax Process" engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Corliss Steam Engines at a bargain. One 12"x42"; one 16"x36"; one 20"x42". All in first-class running order. Henry I. Snell, 135 N. 3d Street, Philadelphia, Pa.

A new set of patterns and templates for 24" swing, 12 feet bed lathe, with all modern improvements, $175. Harrison Machine Works, 1708 Barker Street, Philadelphia, Pa.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Business men furnished stenographers, who are machine operators, without charge for my services. Shorthand taught by mail. Caligraphs sold; special inducements offered; correspondence solicited. W. G. Chaffee, Oswego, N. Y.

BOUND VOLUMES of the AMERICAN MACHINIST for 1880. A limited number for sale at $3.50 per volume, express charges to be paid by purchaser. $4.50 per volume will be charged for 1881 and 1882. AMERICAN MACH. Pub. Co., 96 Fulton st., New York.

"HOW TO KEEP BOILERS CLEAN."—A book of seventy-two pages, telling how to prevent scaling, foaming, priming, and burning, with other valuable information, will be sent to any address FREE of postage, by James F. Hotchkiss, 86 John street, New York.

Any of our readers who have complete files of Volumes I. and II. in good condition, bound or unbound, can probably find a purchaser by addressing us, and stating the lowest price they will accept. AMERICAN MACHINIST PUBLISHING COMPANY, 96 Fulton street, New York.

Patent "Common Sense" Binder for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address, in the United States, by mail for one dollar. To Canada and foreign countries 75c., the purchaser to pay custom-house duties and express charges. American Machinist Publishing Co., 96 Fulton street, New York.

Chordal's Letters.—John Wiley & Sons, 15 Astor Place, New York, have now ready a new and enlarged edition, with six additional plates, of Chordal's Letters, comprising the choicest selections from the series of articles entitled "Extracts from Chordal's Letters," which have appeared in the columns of the AMERICAN MACHINIST; with a steel portrait of the author, and upwards of fifty original illustrations by Chas. J. Taylor. One volume 12 mo. of nearly 400 pages, cloth, $2.00. Will be mailed and prepaid on the receipt of the price.

MANUFACTURES.

Fessenden, Foshay & Co. are erecting file works at Beaver, Pa.

The Hayden Brass Works, at Lorain, O., are now running nine hours a day.

A wire nail factory is being erected at Beaver, Pa, by Hartman & Douglass.

The shops of the Kansas Southern Railroad were burned at Ottawa, Kansas, November 20.

Clausen & Price, brewers, 59th street and 11th Avenue, N. Y., will put in a 60 horse-power boiler.

The shops of the new Bay State Arms Company, Uxbridge, Mass., are nearly ready to start work.

Vanderbeck & Sons, Jersey City, N. J., are putting a 125 horse-power boiler in their planing mill.

A. M. Dodge, Jersey City, N. J., proposes to put two 60 and one 40 horse-power boilers in his planing mill.

W. J. Creamer, corner Grinnell and South Streets, South Brooklyn, N. Y., is about to put in two 25 horse-power boilers.

The Hamburg American Packet Company, Hoboken, N. J., have just placed two 75 horse-power Babcock & Wilcox boilers.

T. C. Eastman is building a large slaughter-house at the foot of West 59th Street, New York, and will put in engine and boilers.

The Black Band Iron and Coal Company, which owns some 4,000 acres of land on Davis Creek, in the Kanawha Valley, West Va., has just started a new blast furnace in that locality. The iron ore it reduces is taken from the land belonging to the company.

The Camden (N. J.) Iron Works will go into operation in a few weeks, employing a large number of foundrymen and machinists.

Oliver Bros. and Phillips, Pittsburgh, Pa., have organized the Iron City Nut and Lock Company, with $150,000 capital. New works will be at once erected.

It is said that Welford Sales, one of the largest cotton manufacturers of New England, contemplates the erection of four cotton mills at or near Petersburg, Va.

The *Boston Commercial Bulletin* says: "Notwithstanding reports to the contrary, the Fall River Iron Works is crowded with work, and has orders ahead for several months."

It cost the Sloss Furnace Company, Birmingham, Ala., $11.90 a ton to make pig iron last year, according to the testimony of Mr. Sloss, the president, before the Senate Committee on Labor.

The Malleable Iron Company, at Bridgeport, Conn., manufacture more than 10,000 different articles, a small part of which is the supplying of the trimmings for 500,000 baby carriages yearly.

The Laclede Car Company, of St. Louis, Mo., a recently-organized concern, is erecting works at the corner of Douglass and May Streets, near the water-works, for the manufacture of street cars.

Havana, Ill., is to have a foundry erected between now and January 1 for the manufacture of drills, etc., a new company having been organized with $60,000 capital, one-half of which is paid up.

The *Cleveland Trade Review* says the Worswick Manufacturing Company, of that city, is running eight hours a day, and the Cleveland Hardware Company nine hours. The latter establishment usually runs twelve hours at this season of the year.

The ten pottery firms of Akron, O., says the *Trade Review*, have formed a pool by which all sales are to be made through one central agency, as has for some time been the practice with the sewer pipe manufacturers.

The American Watch Tool Company, Waltham, Mass., have recently built an addition to their shop, and have taken on a dozen additional hands since the middle of October. They have lately furnished foremen for several machine shops.

The city authorities of Meadville, Pa., are now erecting the necessary buildings to accommodate the machinery to be used in their electric-light plant. The Fuller system has been adopted, and two 10x12 engines of the Ball Engine Company will furnish the power.

Reis Brothers, of Newcastle, Pa., have sold their interest in Neshannock furnace to A. L. Crawford for $95,000. Mr. Crawford holds it until the organization of a company, which is now under way, is completed. The rebuilding of the furnace is rapidly nearing completion.

The Omaha (Neb.) Water-Works Company have lately ordered of the Knowles' Steam Pump Works, of New York, a pumping engine of five million gallons daily capacity. This pumping engine will be of the compound condensing duplex design of Knowles' improved construction, and will take the place of some pumping engines that have not proved powerful enough for the very exacting duty required in this water-works. The pressure which this new pumping engine will have to work against will be equal to a head of nearly four hundred feet elevation.

The Diamond State Car Spring Company was organized in Wilmington, Del., November 1, with $100,000 capital stock. The officers are Nathan H. Davis, president; Lewis C. Gratz, secretary and treasurer; Pusey A. Walton, manager. The company has bought the works of James P. Hayes & Co., in Wilmington, with the intention of continuing the business of making car springs, and extending the trade, adding to it the use of four new patents which it owns. The works have been put in repair, and a number of new machines are to be added.—*Baltimore Manufacturers' Record.*

The Niles Tool Works, Hamilton, O., have issued the following circular: "We desire to announce that we have opened a branch office and warerooms in the new building, No. 153 Lake Street, Chicago, under the management of Mr. W. P. Douglas, late of our Eastern branch, and Mr. John R. Williams, late mechanical engineer for the Union Iron and Steel Company, and consulting engineer for the Pullman Iron and Steel Company. Every opportunity will here be provided to acquaint the purchasers with the details of our machinery, and we propose to keep on hand at this point as large a stock as the condition of trade will admit of. In addition to our own tools, our stock will comprise the product of several other well-known firms, for whom we will act as sole Western representatives, namely, the Morgan Engineering Co., successors to Morgan, Williams & Co., of Alliance, Ohio, builders of steam hammers, Tweddell's system of hydraulic riveting and flanging machinery, etc., hydraulic traveling and hand cranes of all descriptions, and heavy punching and shearing machinery; the Gordon & Maxwell Co., of Hamilton, Ohio, builders of duplex outside packed plunger pumps, water-works machinery of all descriptions, and railway water station and mining pumps; J. F. Blair & Co., of Philadelphia, builders of small lathes; also a number of other makers of first-class tools. We have also opened at our warerooms an engineering department, and are prepared to engineer machinery plants of all kinds; also to act as consulting engineers and inspectors of machinery, iron structures, etc."

Machinists' Supplies and Iron.

NEW YORK, November 29, 1883.

In pig iron the market remains in an unsatisfactory condition.

We quote: No. 1 X Foundry, $20 to $21, the majority of transactions being at $20.50; No. 2 X, $19 to $20; Gray Forge, at furnace, $17 to $17.50.

In Scotch pig there is little or no activity, with prices stationary. We quote Coltness, $22.50; Glengarnock, $21.50; Gartsherrie, $23; Summerlee, $22.50; Eglinton, $20 to $20.50—all at yard. Concessions are offered for future shipment, but are not taken to any extent.

Antimony has advanced slightly, Hallett's being held at 10¼c. to 10½c., and Cookson's at 10¾c.

Copper—Small sales of Lake, at 14⅞c. and 15c.; other brands, 14c. to 14½c.

Lead, in small jobbing lots, sells at 3¾c., but 3.65c. is more commonly offered.

Spelter—Refined, 8c. to 8¼c.

Tin—Banca, 21½c.; Straits and Malacca, 18⅞c. to 19c.

WANTED

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Wanted—Situation as superintendent or engineer. Reference given. Address, A. B., care AM. MACHINIST.

Situation wanted by a first-class mechanical draughtsman. Long experience on varied work; reasonable salary. Address, A. N., care AM. MACHINIST

Wanted—To correspond with traveling men who have business with users of steam and machinery. Men traveling in the Middle, Western, and Southern States preferred. Eagle Iron Works, Detroit, Mich.

Mechanical engineer of long experience wishes an engagement, at reasonable pay, with a party where a chance to make a new patented engine can be had. For information, please address, R. C., *Scientific American* Office, 261 Broadway, New York, N. Y.

Wanted—Situation as superintendent, by a reliable and competent mechanic of experience. Posted in the business. Engines, portable, etc., specialty. Has thorough system of shop management. Best of references. Address, Superintendent, care AMERICAN MACHINIST.

A first-class mechanical engineer and draughts man, with 20 years' experience in the designing and building of automatic engines, boilers and general machinery; and as manager and superintendent, is open to an engagement. Best of references. Address—R 42, AMERICAN MACHINIST.

Draughtsmen—Wanted, several first-class men to work, under direction, on designing new machinery of a high class. Engineering knowledge is essential, and should, if possible, include training both in theory and practice. Address, stating age, references, past experience and compensation expected, W. E. Y., BOX 4, AMERICAN MACHINIST.

Wanted at once—Two first class experienced mechanical draughtsmen. Experience considered as first qualification. Foreigners who cannot talk and understand English will please not apply. Address, giving full particulars, as to years of practice, character of work done, wages expected, &c., Brown & Sharpe Mfg. Co., Providence, R. I.

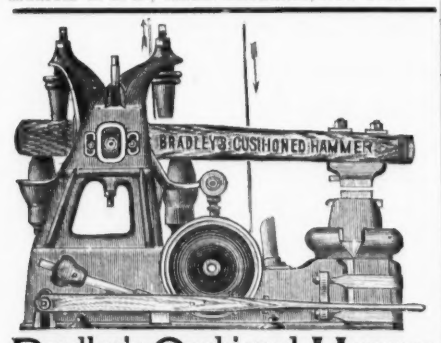
To English Workmen.—A competent man wanted to return to Manchester to take charge of a department making Medart Patent Pulleys. It will be necessary for the workman selected to remain a month at the works in St. Louis, carefully studying the processes of manufacture. Expenses to and while at St. Louis only will be paid. Address by letter only. Medart Patent Pulley Co., 1,306 N. Main st., St. Louis, Mo.

Wanted.—Good second-hand boiler maker's Punch, shears and rollers. Give lowest cash price, and full description. Sulzer & Vogt, Louisville, Ky.

Wanted—Castings to make for some manufacturer. A line of specialties preferred. Address, with full particulars, Vulcan Foundry, 359 and 361 West Randolph Street, Chicago, Ill.

For Sale Cheap.—2 new exhausting fans, 58 in. high, 15x15 in. discharge; 1 new exhausting fan, 66 in. high, 20x20 in. discharge. Hermann Kropff, 117 Railroad Avenue, Newark, N. J.

Wanted, machinery to build—Parties having machine, blacksmith, and bolt shops combined, are desirous of more work. Estimates furnished for all kinds of work. Special prices to responsible parties. Address B. B. B., AMER. MACHINIST, New York.



Bradley's Cushioned Hammer

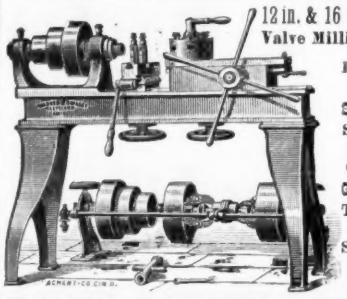
Stands to-day WITHOUT AN EQUAL.

OVER 800 IN USE.

BRADLEY & CO., Syracuse, N. Y.

ESTABLISHED IN 1832.

BRASS WORKING MACHINERY.



12 in. & 16 in. Monitors
Valve Milling Mach's
Double Key Lathes,
Speed Lathes
Slide Rests
Revolving Chucks for Globe Valves,
Two-Jaw Chucks,
Small Tools and Fixtures.

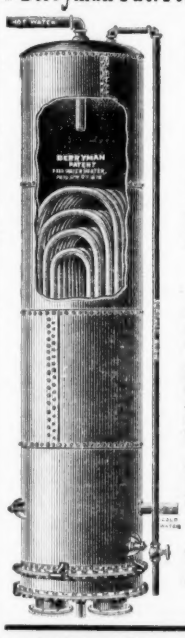
WARNER & SWASEY, Cleveland, O.

WORKSHOP RECEIPTS.

For the use of Manufacturers, Mechanics and Scientific Amateurs. First and Second Series, each containing about 450 pages, with illustrations. PRICE $2.00 per volume. Descriptive circular and catalogue of books for mechanical engineers sent free.

E. & F. N. SPON, 35 Murray St., N. Y.

THE Berryman Pat. Feed Water Heater & Purifier



Manufactured by

I. B. DAVIS & SON
HARTFORD, CONN.

Has seamless drawn brass tubes. The U shape of the tube prevents their being affected by expansion or contraction.

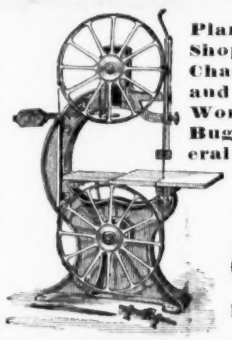
This Heater has been in constant use Ten Years.

None have ever required repairs. Gives the highest results attainable by the use of exhaust steam.

IT IS ALSO THE ONLY HEATER APPLICABLE TO CONDENSING ENGINES, increasing the vacuum and imparting a high degree of heat to the Feed Water.

Benjamin F. Kelley,
AGENT,
No. 91 Liberty St.
NEW YORK.

WOOD WORKING MACHINERY



FOR
Planing Mills, Pattern Shops, Furniture and Chair Factories, Car and Agricultural Works, Carriage and Buggy Shops, and General Wood Workers.

Manufactured By
CORDESMAN & EGAN CO.,
Nos. 201 to 221 West Front St., Cincinnati, Ohio, U. S. A.

COOKE & CO., DEALERS IN
Machinery and Supplies,
22 CORTLANDT ST., NEW YORK.

AGENTS FOR

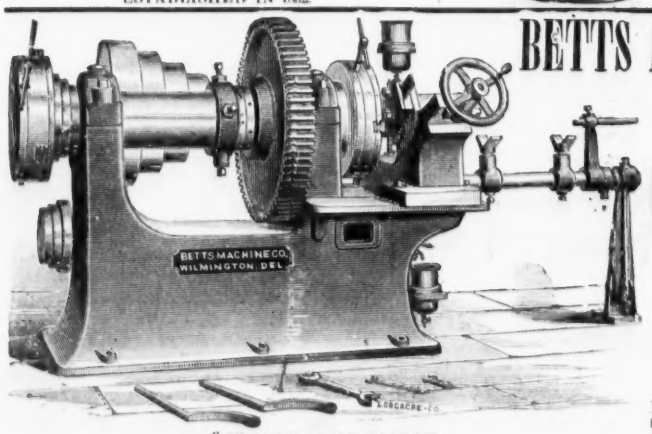
The Waters Perfect Governor.

Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats. Also

SUPPLIES

For Machinists, Railways, Mills, Mines, &c.

Please send for circular and state that you saw the advertisement in this paper.



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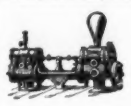

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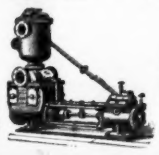

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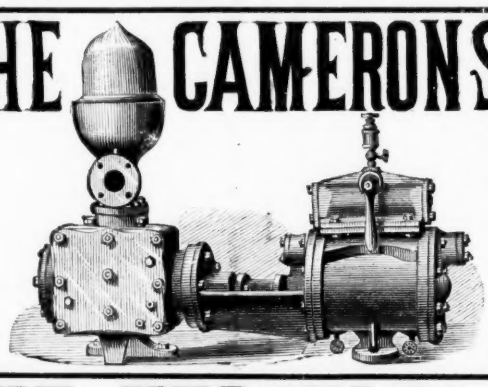

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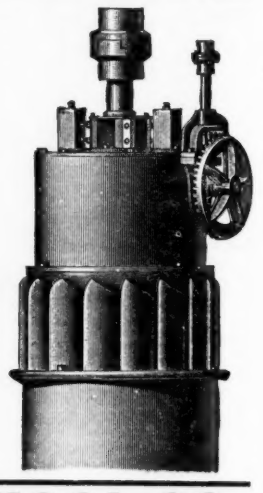

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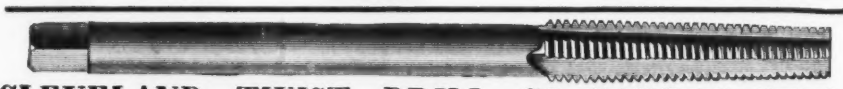

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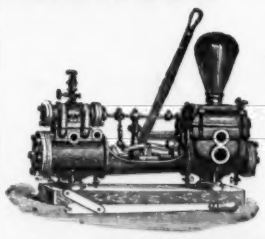

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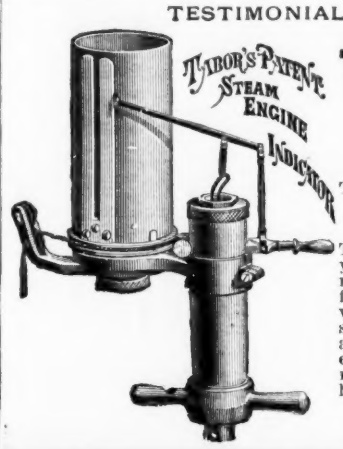

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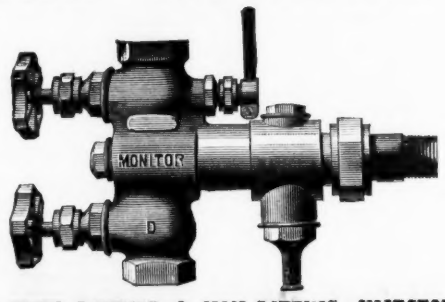

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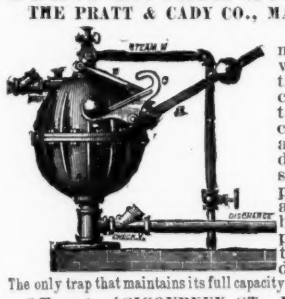

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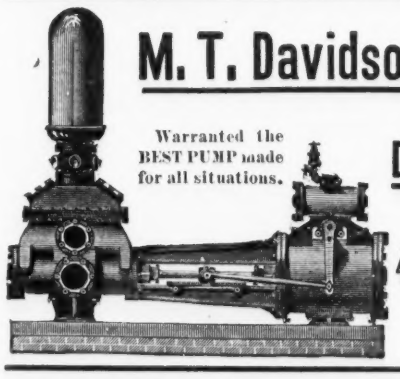

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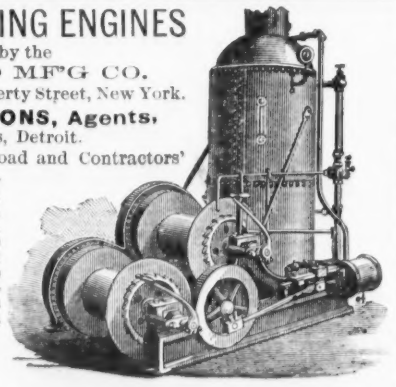

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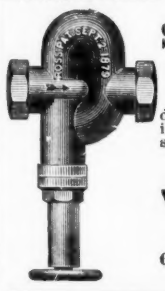

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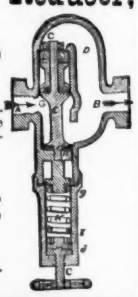

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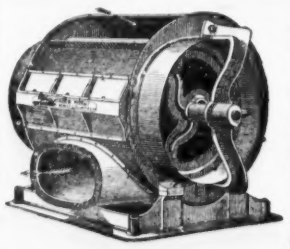

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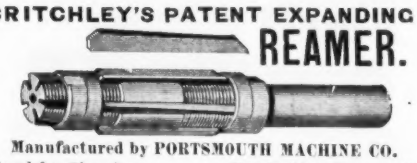

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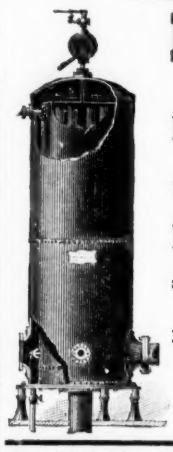

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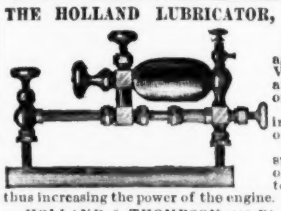

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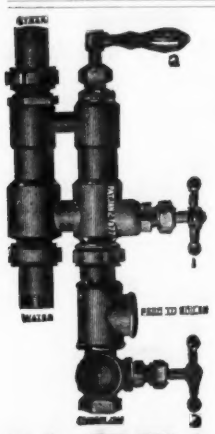

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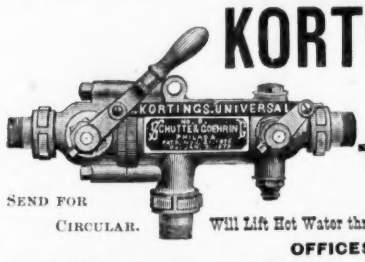

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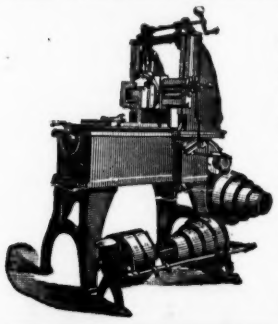

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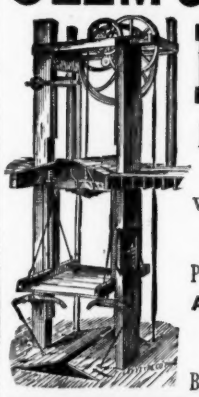

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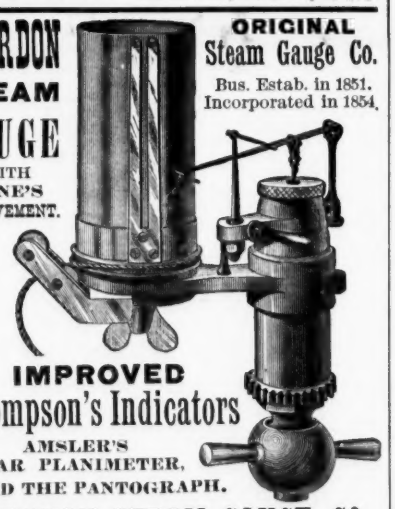

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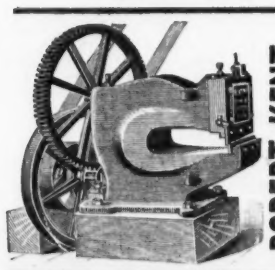

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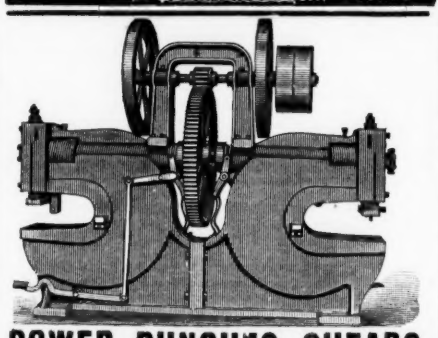

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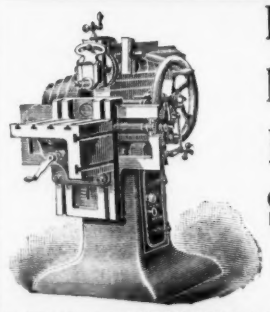

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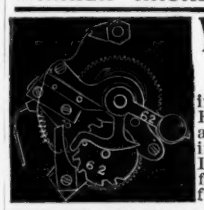

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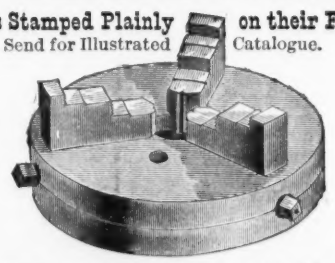

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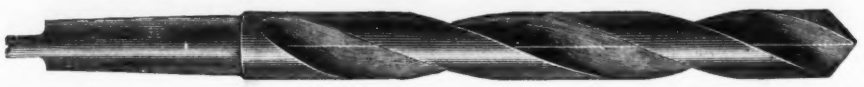

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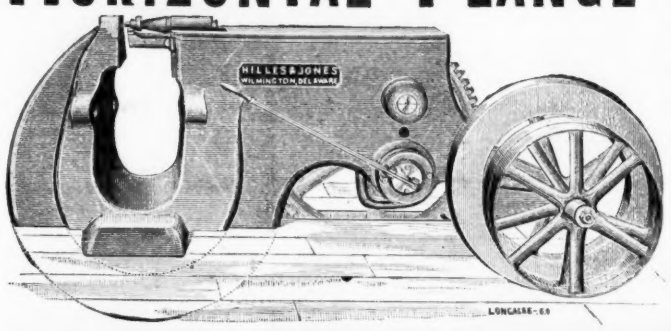

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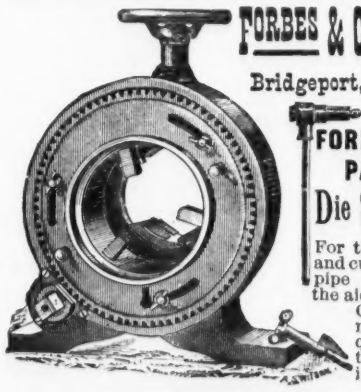

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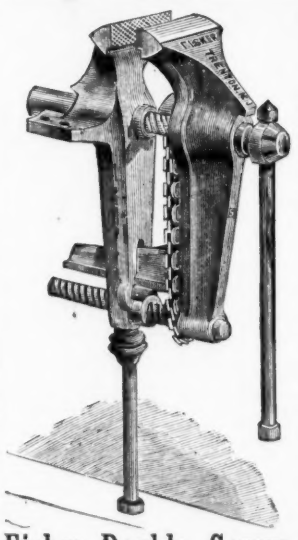

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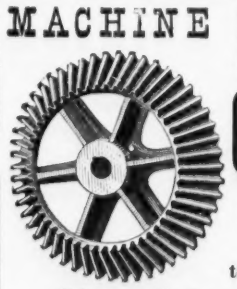

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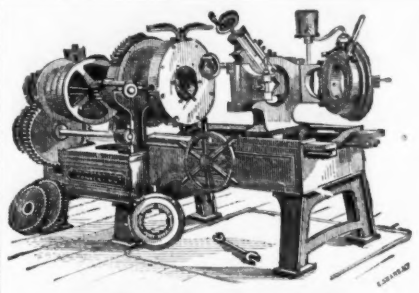

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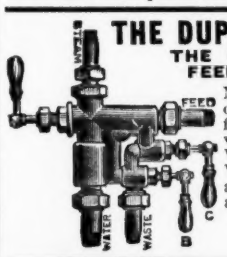

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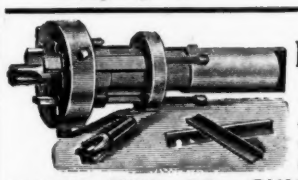

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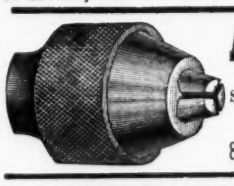

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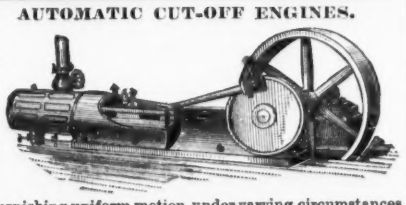

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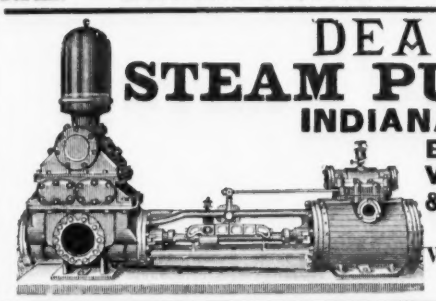

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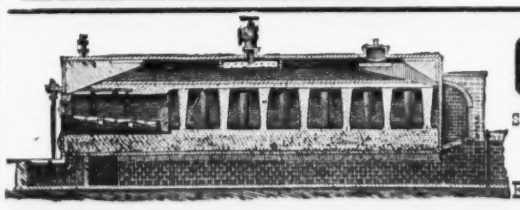

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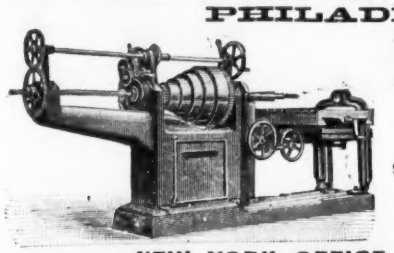

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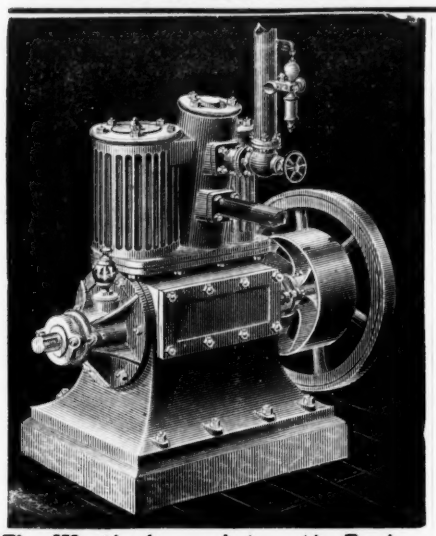

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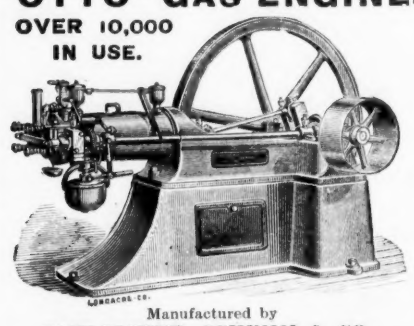

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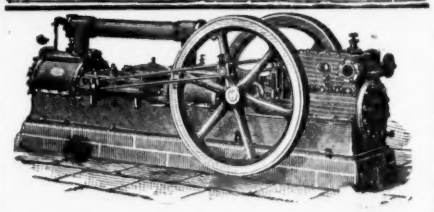

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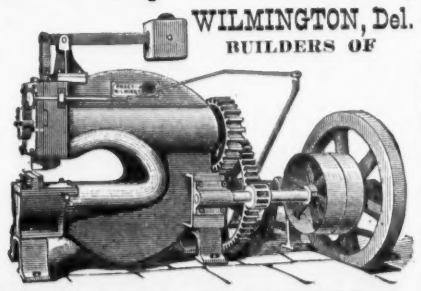

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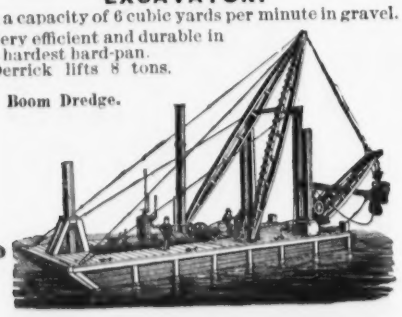

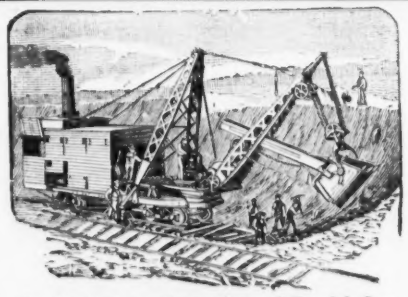

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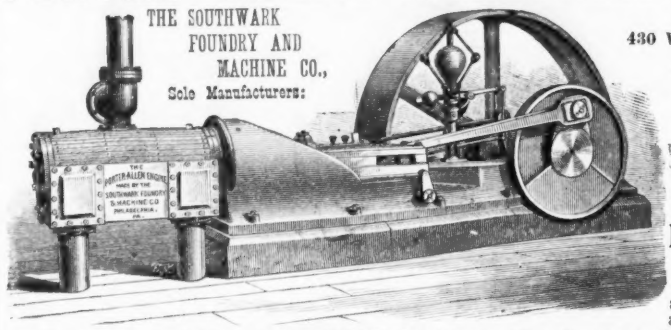

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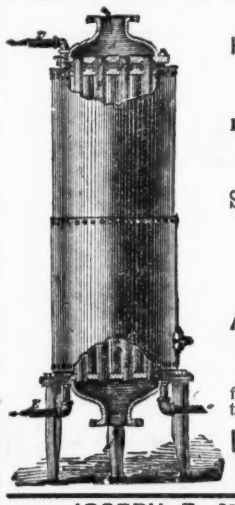

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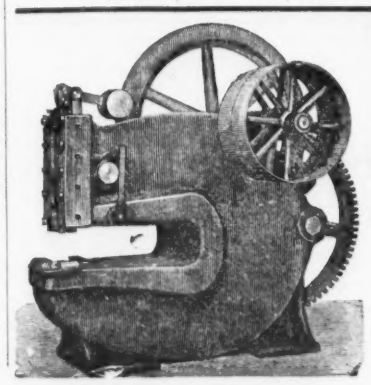

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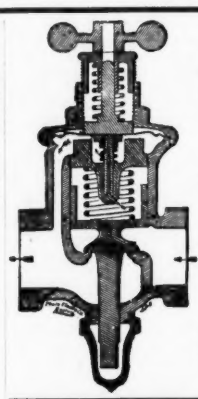

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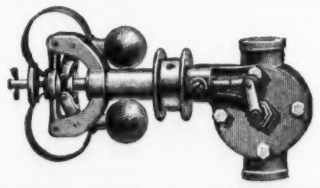

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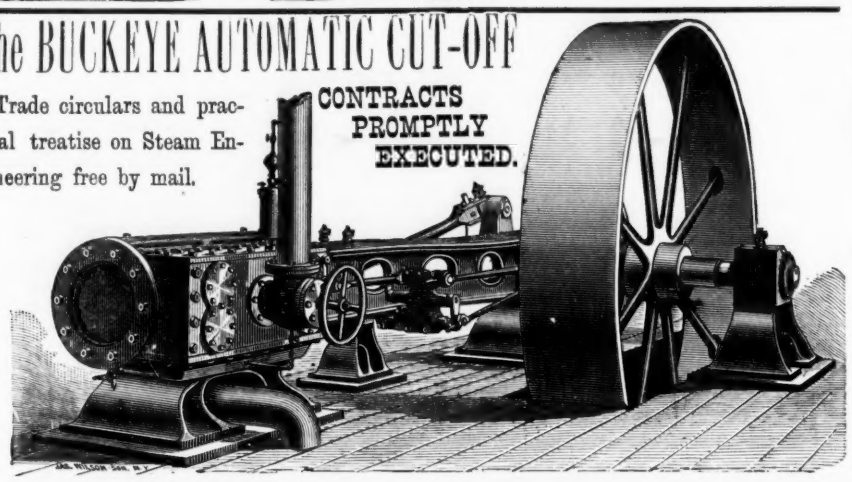

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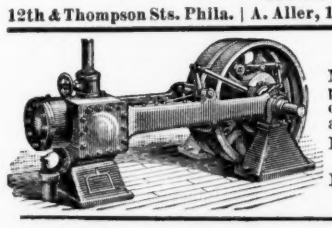

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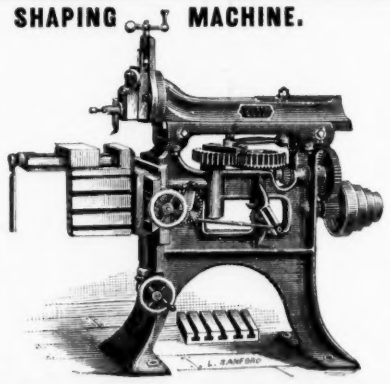

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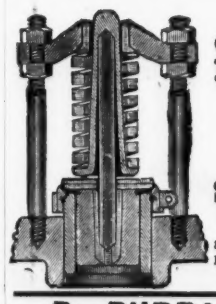

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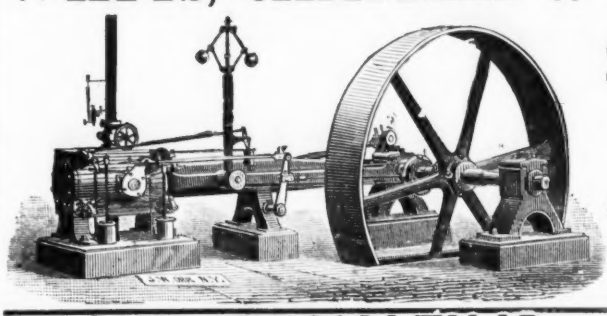

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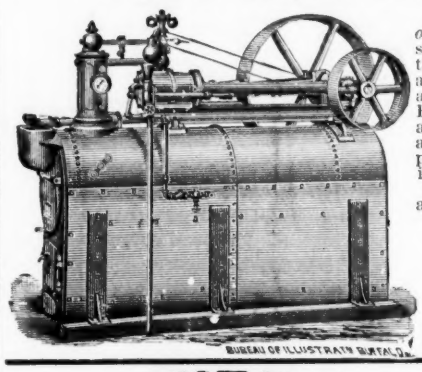

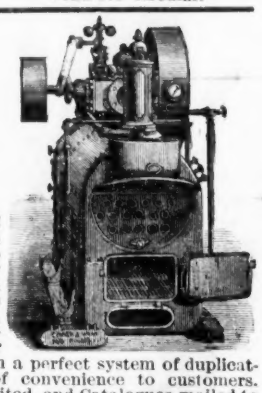

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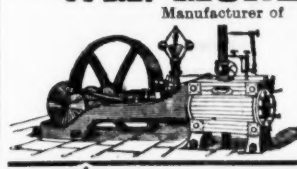

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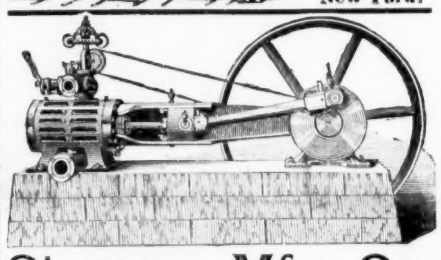

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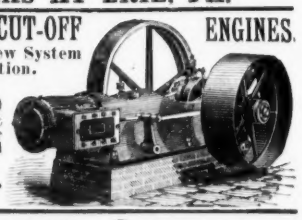

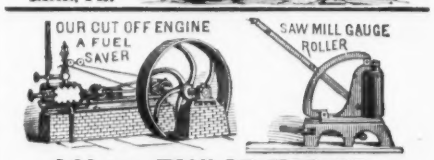

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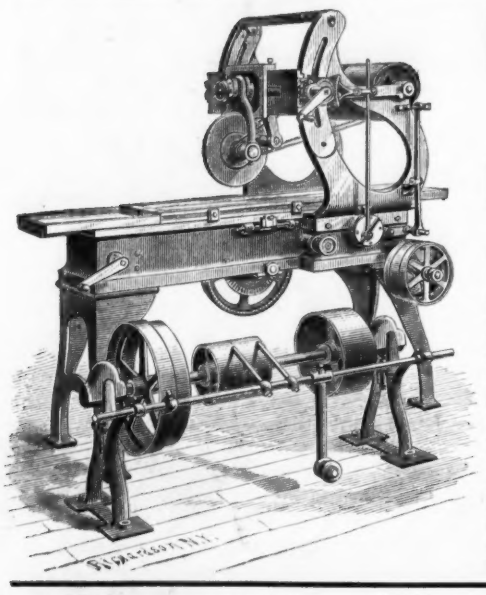

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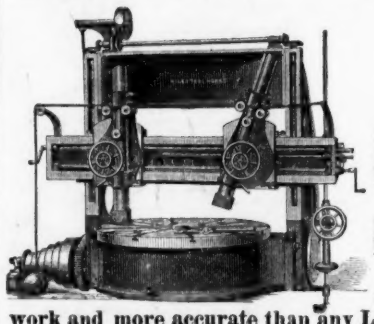

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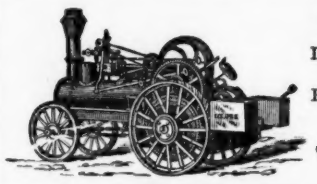

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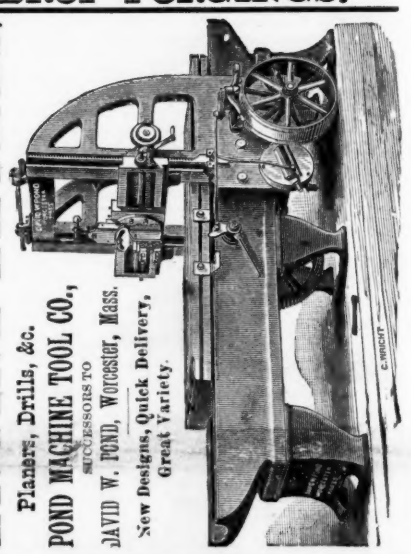

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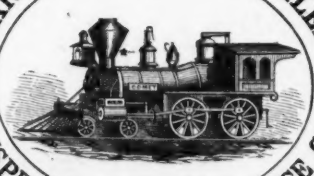

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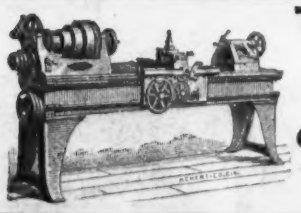

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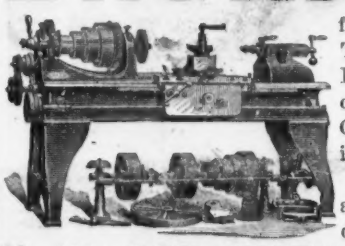

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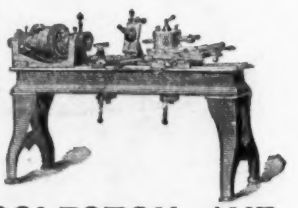

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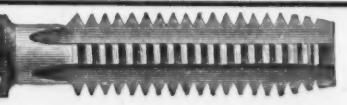

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